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THE FRANKLIN INSTITUTE,

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OF

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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CIVIL ENGINEERING.

Correspondence with the United States Board of Navy Commissioners, being replies to their circular asking information relative to Steam Navigation, applicable to Government purposes.

(Continued from Vol. xi, page 380.)

To Com. Lewis Warrington, *President of the Board of Navy Commissioners, Washington:*

Sir,—In examining, in my last letter, the allegations which we have seen advanced by two patriotic and able writers, against our mercantile steam vessels, I was led to notice, incidentally, some of the most important and valuable qualities pertaining to these vessels; and which now appear to demand the attention of the government. The question of the *relative strength* and security of the light built and finely modeled classes of American steamers, however, was not specially examined, and now claims our consideration.

In my second letter to Commodore Perry, I have alluded, in general terms, to the great injury arising from unnecessary or redundant *weight*, in the construction of a steam vessel, and to the comparative *weakness*, instead of strength, which necessarily results therefrom. I now maintain that the average quantity and weight of materials employed in the construction of steamers of classes C and D of our table, is fully sufficient for their best security, for any judicious purposes of war or commerce; and that the hulls of these vessels, even as now

constructed, are quite superior in *comparative* strength and sea-worthiness to the average classes of merchant vessels, heavy steamers and ships of war.

The facts and considerations, which have been adduced in the foregoing examinations, are probably sufficient to sustain this position; but I prefer, for further illustration, to compare the construction of these light steamers with that of the magnificent steam ships of class A. Now the floor frames or timbers of classes C and D, forming the base of construction, are moulded nearly, if not quite, as deep as those of the steam ships; but are sided, however, to a much reduced width or thickness, thus affording a more advantageous selection and application of the material, and dispensing with an unnecessary and injurious weight. Instead of half floors and double-futtocks, by which the frames of the ships are often greatly weakened, nearly all the timbers of class C are whole at the keel, and extend to the sides of the vessel, where, by means of a well selected and proportioned futtock, and top timber, the frame is extended to the deck with but one joint or breakage, which is most strongly supported. It is probable, however, that the *frames* of either of the four classes in the table have strength much more than sufficient to resist any external pressure or other strain which can possibly accrue to a water borne vessel, properly loaded. But the actual strain upon the frames of each class in a sea-way, the *length* being equal, will be nearly in proportion to the square of the diameter of the vessel, and its entire weight; except as this strain may be increased by the want of heavy plunges and active buoyancy. Hence, although there is more space between the frames of the light classes than in the heavy steam ships, yet the available strength of the frames and other material, *as compared with the weight and amount of strain* respectively, will be found greater than in the class of heavy built steam ships.

In regard to the longitudinal frame work and the keelsons, by which the lateral frames or ribs are connected together in one firm structure, I may state that the keelsons of the light classes are as numerous as in the large steam ships of three times their tonnage, and four times their weight; and that the sizes of these keelsons are, at least, in equal proportion to the weight of the vessels: while the longitudinal framing at the turn of the bottom or bilge, and also at the line of the deck, parts of vital importance to the strength and security of a steam vessel, exceed, in *comparative* strength, security of fitting and longitudinal tenacity, those of any other vessels known. These connexions are bound together, laterally, in the strongest manner, by large screw bolts passing through the frames from outside to inside; no less than *four thousand* of these bolts being sometimes used in the construction of a common steamer. The framing and securities of the decks of these steamers are also arranged in such a manner as to dispense with a great amount of unnecessary and injurious weight, while their durability and available strength are thus greatly increased.

Thus it will appear that these steam vessels are constructed and secured in a manner well calculated to relieve the frames and planking from injurious strain in a sea-way. Their sides, also, are often

supported by diagonal framing or ceilings, securely fastened upon the interior portions of the frame; so that the general frame work of these vessels is in all respects as safe and unexceptionable as that adopted for the heavy steam ships.

But after all, the chief danger from weakness or dislocation in a steam vessel at sea, pertains to the external planking, which must necessarily sustain the maximum tension of the vessel; and, without a loosening or disjoining of the seams by longitudinal or tortuous strains, there can be no hazard to a water borne steamer, except such as may arise from the want of sufficient buoyancy to keep out the sea, or from the disruption of the bottom, or of the water-pipes leading through the same, by some accident pertaining to the engine.

On comparing the strength of the outside planking in the several classes in the table, I find that the planks of some of the best steam ships of class A have a thickness of four inches for the bottom, and five inches for the sides of the vessel; while in class C the bottom planks are three inches, and those of the sides four inches in thickness. From this we may compute the areas of solid planking on the midship cross section of the sides and bottom of the steam ships as being equal *to twenty-seven square feet;* and, by the same approximate rule, that of the steamers of class C may be computed as averaging *twelve and a quarter feet.* Now the average of the entire weight of each of these two classes, as seen in line 6 of the table, is 2360 tons and 580 tons respectively: a proportion of *near four to one.* This shows the *comparative* strength of the planking in class C to be almost double to that of the best steam ships of class A. It is true, that the average length of the four coasting vessels of classes C and D exceeds that of the steam ships of class A, by an average difference of seven feet; but this is more than compensated by the greater ease and fineness of the head and stern in the two lighter classes.

We may safely claim, therefore, that American coast steamers, like those in the classes C and D, possess a degree of relative or comparative strength which exceeds that of the heavy steam ships employed in transatlantic navigation. I speak not, however, of the suitableness of their interior or exterior arrangements for the purposes of war, nor of the particular positions of their engines and boilers, but solely of their general proportions, the quantity and weight of their materials, and the tenacity of their construction. Any additional weight which may be *essential* for naval purposes may be more than compensated by that which can well be spared from these vessels.

But there are objectors who will doubtless refer with confident assurance to the loss of the American steamers Home, Pulaski and Savannah, as refuting my position. And the prevailing misapprehensions or delusions in regard to the first case here mentioned, and the unhappy influence of these errors upon our national interests, require that the case should be particularly noticed on this occasion.

I may first state, however, in regard to the Pulaski, the well known fact, that the loss of this vessel was directly occasioned by an explosion of the boiler; and the case, therefore, comes not within the scope of the present examination.

I may further premise, that the disasters and losses by coast steam navigation at the period of the loss of the Home, 1837, were by no means confined to that vessel: not less than eight British steamers having been wrecked or foundered in that year or the winter and season following, and great loss of life and property thus occasioned, not including here numerous other British losses of the same period, by collisions, fire, and the explosion of boilers. If, therefore, an American steamer was lost by stress of weather, it can afford no valid argument against American steam vessels.

But the American public has been led to believe, and I confess that I had myself yielded at first to the impression, that the loss of the Home was directly caused by a general straining of her hull, in a gale at sea, and from the want of adequate strength and tenacity in her general structure. This was so confidently argued and sworn to, that no one, unless particularly acquainted with all the facts of the case, could withhold his credence to the allegations.

After the lapse of more than three years, however, a legal investigation, full and elaborate, has been had of this case, and a most thorough inquiry has thus been made into all matters and circumstances relating to the qualifications and loss of the Home. Of the great mass of evidence thus brought to view, I have not room to speak in detail; but it may be sufficient to state, that the principal allegations so confidently urged against this vessel prove to have been founded only in the ignorance, the fears and the misapprehensions of a portion of the passengers: the most remarkable of these being persons who claimed to have knowledge and experience of nautical affairs.

The only immediate cause of the disaster was found in the vessel's having sprung a-leak, at some undiscoverable point, while weathering the shoals of Cape Hatteras in a gale from the North East, with an unusually bad sea. After weathering the shoals and bearing away to the southward of the Cape, this leak increased, until the fires were extinguished in the boilers: when, at the solicitation of passengers, the vessel was run upon the breakers of that dangerous coast, and the larger portion of the passengers and crew were drowned.

But this case is too important, in a professional view, to be summarily passed over; and it is hoped that the whole evidence will yet be given to the public. For, stimulated by the clamors arising from this distressing case, and that of the Pulaski, which soon followed, Congress has been induced to adopt a scheme of legislation tending greatly to discourage or destroy our steam navigation, particularly on the ocean, where our own laws will no longer permit an equal competition with foreigners. Similar clamors, founded on the more numerous disasters of the British coast navigation, and aided by the American example of legislation, were brought to bear on the British Parliament. But that government, notwithstanding its great predilection for penal laws and complex schemes of legislation, could not be induced to lay onerous restrictions upon steam navigation, which is so essential to national strength and prosperity. On the contrary, England has, by the direct appliance of her bounty and patronage,

at this very crisis found means to cover the Atlantic, Mediterranean and Indian Seas, with steamers of gigantic size; and now proudly contemplates the resistless power by which nations may be held to her will.

But to return to the Home. This unfortunate vessel was constructed and equipped by Mr. Allaire, an enterprising engineer, who had been engaged in the construction of engines and steam vessels almost from their first introduction. With a mind apt to appreciate the means necessary for safe navigation, he had ventured, some years previous to this period, to equip and send forth the David Brown, a truly American steamer, upon the waters of the Atlantic; which, notwithstanding the fears and predictions of nautical men, proved an excellent and sea-worthy steamer; which, in later years, has been employed in the West Indian seas, till now rendered by the climate unfit for service.

Two other steam vessels were successively placed on the route from New York to Charleston, by Mr. Allaire and his associates: each winning additional confidence and applause from the observant navigator. One of these vessels having been lost by error of the pilot, a third and still superior steamer was placed upon the route, replete with every improvement of proportions, strength and equipments, which years of experience in this navigation had suggested; and so entirely assured was the owner of her sea-worthiness, that no insurance was applied for, except on a fraction of her value, for the particular benefit of a private creditor. This vessel was the ill-fated Home.

The Home had, of course, been condemned in advance, by certain nautical prophets, as has been common in all early attempts at ocean steam navigation; and, on the completion of her first voyage, was greatly traduced, through the ignorant misapprehensions of passengers and others, many of whom had mistaken the arched form which had been given to her deck for its greater strength, and which was most strikingly visible at two points, forward and aft of the centre, which, viewed in connexion with the usual depression of the wheel guards at midships, was taken as conclusive evidence of that injurious strain which is designated by the term *hogged*. Another effective scarecrow had also been found in a single set of bearing-braces, above the gunwale, on each side, which were intended to distribute more extensively a part of the weight of the engine and boilers.* These braces, however, being placed at a very low angle, broke loose from their shoe or socket on the deck, at their forward ends, by the elastic movement of the vessel in a heavy sea, as might reasonably have been expected; causing a slight dislocation in some light work above the deck, which had been attached to these braces, and which formed the enclosure of an upper state-room on the guards, occupied by a passenger. This trivial accident on her first voyage, caused considerable fright among timid persons, who had been taught to believe that

* It should be noted here, that the boilers were placed in line, one before the other; a most favorable arrangement for extending their weight and equalizing the strain of the vessel.

almost every thing is wrong and extra-hazardous in American steam vessels; and the laying of a foot-mat over the end of the dislocated brace, while in Charleston, was construed into an act of desperate treachery to the lives of the traveling public.

On arriving at New York, on her return voyage, the vessel was strictly examined by her builder; and, except this harmless matter, and the loosening of a small piece of plank on one of the extraneous spondings, every thing was found in perfect condition.

The second voyage of the Home was made without any notable occurrence; but on leaving port on her third and fatal voyage, she was soon overtaken by a north-east gale, and, meeting with an injury in a feeding pipe of one of the boilers, she bore up for the Chesapeak. This injury having been temporarily repaired, she then stood on for Cape Hatteras; but, owing to the previous alteration of her course, made the land about sixty miles northward of the Cape—the sea at this time being heavy, and the gale increasing. Steering now nearly in the trough of the sea to weather the Cape, the Home passed over the Wimble Shoals on which the sea was then breaking with great fury, and three of the rollers broke on board, so far only as to dash inward one of the gangway boards on the outside of the guards, abaft the water-wheel, together with two or three of the sash windows of the light built saloon cabin, which occupied the greater part of the after deck; and this small affair was the only thing like the boarding by a sea which occurred to the Home during the whole of this trying occasion, till she was partially water-logged, and finally, though unwisely, run into the breakers of the outer sand-bar on the coast of North Carolina.

After passing the Wimble Shoals, the Home had been headed up still more to the eastward, in order to weather the Hatteras Shoals; and shortly before passing these shoals was discovered to have sprung a leak. Much search was made for the mysterious leak, but without success; and the melancholy result is already stated.

It of course happened, that the overhead braces of the Home again broke loose in this gale, at the same point as before: and to this circumstance, and to the elasticity necessarily and properly manifested in a vessel of her length in a rough sea-way, much of the unseasonable panic is to be ascribed which had early manifested itself among the passengers. The size and relative dimensions of the Home were but little below those of the Neptune, which has since run so successfully on sea routes, and at times in the very heaviest weather. But the elasticity of a vessel, (a quality inseparable from the materials used, and which is also *conservative of strength*, when not unequally and improperly opposed,) will, in its visible extent, be always as the *square* of the vessel's length, and inversely, perhaps, as the square of her depth. It appears that this elastic motion of the Home at each alternate vibration from the impact with the seas, was mostly seen in the forward body by observers standing aft; but in the after body by observers standing forward; and in both the forward and after body by observers at midships.

The extent of this motion was not strictly ascertained; but one of

the witnesses thought he saw the extremity of the dislocated brace move obliquely to and fro, past the joiner work remaining attached to the vessel, to the extreme extent of ten inches. This includes the aggregated range of the two opposite vibrations, the parts compared, moving in opposite directions at the same time, the braces remaining fast at their after ends were thrust forward by the lifting of the stern, thus meeting the lifting motion of the bow; and so *vice versa*. This may give a positive tangential motion at these points of two and a half inches in each direction, to produce the above result, and perhaps more. Now in a vessel of limited depth, and exceeding two hundred feet in length, the above is but a small vibration, and does not equal the degree of elasticity which is often shown in strong mahogany furniture, when standing unevenly on a floor. I have sprung vibrations, by means of my own weight, on the largest and finest trunk of squared white oak timber that I have yet seen, to the estimated extent of two feet; and I am informed by Capt. Ericsson, that the steam ship British Queen, a vessel of nearly *twice* the depth and width of the Home, has vibrated in a gale to the extent of *eighteen inches*.

As the elasticity shown by the Home was naturally associated in the minds of the passengers with the dislocation of the braces, and was more particularly noticed by them near this point, this motion was considered by many as having caused the subsequent leak and disaster, by straining the sides. But those who understand the construction of this vessel know that her deck presented the weakest surface of tension; in which no one pretends the butts had opened in the slightest degree. The sides come next in the order of strength and tenacity; and her bottom was greatly the strongest of all. Therefore, if there was any straining or opening of the seams to produce dangerous leakage, it must have been in her sides. I have since had the satisfaction of examining a portion of the wreck of the Home on the beach, comprising one of her sides and the forward body, the point where the greatest bending was represented as having been seen, and, to my surprise, I was unable to detect the slightest opening or defect in the seams or butts of the outside planking; not even to the slightest crack or opening in the coat of paint with which they were covered. On the contrary, these seams all appeared in as perfect condition as when the vessel was on the stocks.

I have forborne to mention that from *all* the testimony it was quite apparent that the behavior of the Home, as a sea-boat, was entitled to great admiration; and that, as compared with that of another steamer of acknowledged good qualities, which was then on the same coast, but had passed the shoals before the crisis of the gale, or as with that of the British ships as reported by their passengers, the Home would be found greatly superior to any of these vessels.

I have been thus particular in the above examination, because of the highly injurious effects which the current misapprehensions of this case have occasioned to our steam marine; and I now pass to the case of the Savannah, which was recently lost in circumstances mainly like those of the Home.

The steamer Savannah was built in 1838, by one of the best build-

ing firms in the city of New York, for and under the superintendence of Capt. Cobb of the Liverpool packet trade. Her length, 160 feet, was a little less than eight times her breadth; and she was in all respects a sufficiently stout and well-built vessel, constructed ostensibly for the Liverpool trade, but really for a coast steamer. In 1839 she was sent to Savannah, and was employed on the coast route, between that city, St. Augustine and Charleston. Returning to New York, she was next sent to the Gulf of Mexico, and was employed in 1840 between New Orleans and Galveston, in Texas, where she encountered much rough weather. Returning again to New York, she was refitted, and sailed once more for the Gulf of Mexico, in November 1841, with a large supply of coal, and encountered a gale from N. E. when northward of Cape Hatteras. Having made the land of the Cape during the gale, the steamer was headed off shore between east and south-east, in order to weather the shoals, in a bad sea. In this situation, without any visible straining, the vessel behaving nobly, shipping no seas except in sprays, and so steady and easy that a water-cask on her forward deck was left unlashed, being only chocked by sticks of common fire-wood, the steamer sprung a leak; which increased so rapidly in spite of the engine pumps, that the fires became extinguished, and the crew and passengers finally took to the boats, the gale having at this time chiefly abated.

Capt. Crane, who commanded the Savannah, is an experienced seaman, and had navigated the British steamer City of Kingston, from Baltimore to England—she having gone from the West Indies to Baltimore for repairs. He had also navigated the small iron steamer R. F. Stockton across the Atlantic. Capt. C. describes the Savannah as being greatly superior to the City of Kingston, as a sea-boat; and behaving as above in a gale not of the greatest severity, but with almost the worst sea he had encountered. His confidence in the sea-going qualities of American steamers is not in any degree lessened by this disaster, and he seems to prefer these as sea-boats to any other vessels. He ascribes the loss of the Savannah, conjecturally, to the dislocation or fracture of one of the large discharging pipes which communicated from the engine through her bottom; and this opinion is probably correct. This appears also to be the only probable solution of the loss of the Home. It is known to many that the Home, Savannah and other steam vessels of that period were fitted, most unfortunately, with discharging pipes of *cast-iron*—an undoubted oversight which renders the above conjecture sufficiently probable.

My confidence in the strength and general sea-worthiness of these classes of American steam vessels, therefore, remains wholly unshaken; and I shall greatly deplore if the march of improvement be turned backward, and the essential interests and security of our country be compromitted, in the vain hope of avoiding liability to the accidents and dangers of the sea, by means of an unavoidable weight and solidity of construction.

There are considerations, also, which show that the available strength of a vessel of large dimensions, *cannot* be increased in propor-

tion to the thickness and weight which may be added to the planks, timbers, and fastenings; and that all such additions, beyond certain limits, contribute, in an increased ratio, to the actual strain and consequent insecurity of the vessel in a heavy sea. This difficulty is increase by the fact, that in the common methods of construction only a small part of the material employed is made fully available for strength. As most of the fastenings when the vessel labors in a sea receive the strain *laterally*, in the direction which affords the least effectual resistance, and as the small surface of the metallic fastenings have their fixed bearings only upon the softer wood which encloses them, they are necessarily pressed into the latter when subjected to a violent strain, and the seams thus become loosened; the greater portion of the entire mass of timber and planking performing little or no actual service in maintaining the original tightness and integrity of the structure.

It is for this reason that iron vessels have been found so much lighter and more buoyant than those of timber, for, excepting the loss which results from riveting, nearly the whole strength of the iron plates is made available. The loss which is here excepted probably does not exceed one-third—leaving unimpaired and available two-thirds of the orignal strength of the iron. But, from the more unyielding nature of this material, and from unequal and reciprocating strains at some of the points of junction, which may necessarily result from the elastic movements of the vessel in a sea-way, the use of iron vessels seems to be attended with some degree of danger.*

It is probably better, therefore, to adopt a plan of construction by which the strength of the planking and timbers is rendered more completely available, and by which the strain of the vessel in a rough seaway is confined almost entirely to the woody fibre, thus relieving the metallic fastenings, which, instead of being loosened in their bearings by the heavy lateral strains they commonly endure, will have little other duty than that of confining every part in its own place, by their longitudinal and most available strength. But before explaining this method I beg leave to ask the attention of the Commissioners to the following extract from a communication in the Nautical Magazine:—

"As to the strength of iron steam vessels to those of wood, as compared with weight, we shall find the advantage greatly in favor of wood. In the experiments of Rennie, Smeaton, and Barlow, it will be found that dry fir, as compared with iron, weight for weight, is about 9 times as strong in direct tension, 7 times in direct thrust, and 6 times in the transverse or lateral strain. In other words, a bar of wood say ten feet long, of the same weight as a bar of iron of the same length, and one inch square, will carry nine times the weight of the iron bar; will bear seven times the weight in direct thrust; and six times the transverse strain. The strength of teak, oak, and some other hard woods, is not equal to fir, but three or four times greater than iron." "The true principles of naval architecture," as this writer justly says, *"are exemplified in using the exact quantity of*

* *Vide* the case of the Nemesis in doubling South Africa, and the foundering of an iron steamer in the German Ocean.

material, and no more than is necessary for the purpose required." *Naut. Mag.* 1838, vol. iv, p. 256.

It is found that some of the lighter American steamers have a draft of water not exceeding that of the iron steamers constructed in England with so much care for the service in China: while in speed and other efficient qualities they greatly exceed the latter. It appears, then, that if my object of rendering available the chief strength of the wood employed can be obtained, we may possess wood-built steamers with perhaps equal lightness of draft with those of iron, and of greatly superior strength and safety.

In the plan of construction which I recommend, we increase the moulded dimensions of the frames, but reduce the sided dimensions in an equal or greater proportion; the whole moulded surface of the frames being also smoothly planed and well and securely fitted, by screw bolting, etc. In putting on the planks, each plank is first carefully fitted to its place, and then is *checked in* to the depth of half an inch or more, upon, or over, the several frames which it crosses, and is driven on, so as to bind very tightly upon each of the several frames. At the points where the butts of the planks meet, a scarf is formed of length sufficient to rest on these frames, of which the central one, by means of the excavated check, forms a key or fid, holding the two planks fast together longitudinally. When three or four continuous strakes have been thus laid on, the next succeeding one is checked *into, instead of over, the frames,* to the same depth as the previous overlocking: thus bringing the inner surface of the planks in line with each other, and securing them against the caulking strain and torsion of the vessel. When this strake is laid on, the *overlocking* is repeated as before, and so on, alternately, from the keel to the deck. The ceiling planks, in the light classes of steamers, should be entirely omitted—as a saving of weight, a security against unobserved leakage, and to insure the greater durability and strength of the main planking and frames; but any strength which the ceiling might have afforded is to be more than compensated by a system of strong diagonals, which are also to be interchecked or locked upon each other, and also all over the frames which they are made to cross, and are to be secured to each frame with screw-bolts in the strongest manner.

This plan of construction I adopted practically in 1835; and it has also been partially adopted in the construction of Cunard's steamers—which have thick strakes interchecked upon the frames, at intervals, on which great reliance appears to have been placed. The sketches Plate 1 may show more clearly the manner in which the checking or interlocking is effected. In heavy and close framed ships, however, the checking can be best effected by moulding the alternate frames, with an alternate outward and inward projection of their sided surfaces to the extent required for this purpose.

It has been a very common, and sometimes, fatal mistake, to endeavor to obtain buoyancy and lightness of draft in a steamer by *increasing the proportionate breadth.* Of this error there have been some notable examples in the New York navigation and elsewhere, by means of which several highly respectable enterprises have been

broken up, or greatly limited in their success. However plausible the idea may appear, it is evidently founded on a false principle of construction, as may be easily shown; and it should never be attempted in practice. If greater floatage or buoyancy is desired than can be afforded by a steamer of the dimensions, and having its floor frame properly extended, it should be obtained by adding to the *length* of the midship body of the vessel, rather than to the width, and by a reduction of *unavailable* weight in the several parts. By this means any given addition to the weight and measured tonnage of the vessel, within practicable limits, will afford greater flotation, and with less diminution of effective strength and speed than can be attained by like additions of weight and tonnage when made to the *breadth* of the vessel.

I have now to offer some remarks on a better adaptation of the light classes of steamers to the objects of the naval service.

1st. The proportion of length to breadth in these steamers should never be less than the average of class C—the length being equal to *nine breadths* or *diameters;* and, if extended to nine and a half, or even ten diameters, this will perhaps be within the limits of maximum advantage. These ratios of length are especially required for objects yet to be noticed. The proportion of *depth,* however, may be slightly increased, if sufficient care be taken to restrict the top weight.

2d. The extreme horizontal outline of the deck and guards should be brought *within* an angle of fourteen degrees from the midship line at the bow and stern; in order not only to ease of motion, but to favor the deflection of the shot of an enemy from the hull when engaged *head or stern on.* The bow and stern angles at the water line will necessarily be much finer—say within the semi-angle of eight or ten degrees. The stem and stern post should be nearly vertical, and the floor frames, or at least their rudimentary forms, should be extended forward and aft to the joinings of the stem and stern post; dispensing altogether with the common "dead wood" of the stern. Suitable provision should also be made for steering in opposite directions, with either stem or stern foremast.

3d. The deck frame should consist of plank-sawed and deep-moulded scantlings, one to each frame of the vessel, and screw-bolted to the same in crossing to the guard or fender line. The common deck knees should be dispensed with, and snug knees of hackmatack be applied externally, at proper intervals, where the projection of the guards will permit.

4th. There should be a very light hurricane-deck over the central portions of the hull, and extending to a length equal to two or three diameters of the vessel. All the constructions above deck should be of the very lightest description, and be comprised, if possible, within the same limit. Thus the forward and after ends, each to the extent of about three diameters of the vessel, would be left free of incumbrances; excepting the gun fixtures and other indispensable attachments.

5th. The engine should be so placed below deck as to act directly upon the cranks, as in the steam frigate Missouri, if the midship body

of the vessel will allow of this arrangement; otherwise, a half-beam arrangement may be resorted to. The paddle-wheels should spread less on the shaft than is common in American steamers, and the paddle be extended to a point at its centre in a trapezoidal or triangular form. This form will admit of a greater immersion, and thus obtain a better resistance, than the common paddles, especially in a sea-way. The crank and chimney openings in the deck should be comprised in a narrow enclosure, with upright sides, extending fore-and-aft-wise to a point so as to present an acute angle of deflection, for the protection of the crank and lower part of the chimney from shot when *end on* with an enemy. The main shafts, which must be above the deck, should also be protected by *deflecting planes* covered with iron and slightly inclined from horizontal.

Much apprehension has been sometimes manifested for the safety of the wheels and paddles when under fire; but those who have employed steamers day after day, for successive seasons, in encountering ice from four to fourteen inches in thickness, and who have witnessed the speed of a steam vessel when one half or more of the wheel arms and paddles have been disabled in this service, will think more lightly of this hazard; to avoid which, almost every quality valuable for a war steamer has sometimes been sacrificed.

6th. To sustain the guns, the scantlings beneath them should be somewhat enlarged in thickness, and securely stanchioned and screw bolted. The gun pivots should be of strong timber, adequately secured to the deck-frame, and extending to the keelsons. The deck, where exposed to the action of the guns, should be strongly sheathed, and the whole be secured, if needful, by transverse bars, strongly bolted or clamped to the deck-frame; and, if necessary, connected by vertical bolts and stanchions with the floor-timber. When about to engage, sand bags, or other equivalent weights, may also be used for covering that portion of the deck exposed to injury from the explosion of the guns.

To illustrate my views of the proper form of construction of these vessels, I annex an approximate sketch or outline of the deck plan and guards. This outline has, for its base, the elongated rhomb *a, a, b, b*, fig. 3, and presents at the deck a guard line of the bow and stern, *a, a*, the maximum semi-angle of fourteen degrees; which is only equal to that which has been already adopted in some well proportioned steamers for coast service. It also contemplates a length which is equal to nine diameters of the vessel; each of these diameters being visibly set off on the plan. It will be found practically, that this proportion of length is sufficiently limited; for the engine, if placed as proposed, will require much length, and the necessary weight must, also, for a light draft, be extensively distributed. Moreover, the first diameter at each extremity, the flotation of which can properly support little more than itself, may be viewed as substituted for the cutwater, bowsprit and other fixture, which is commonly attached to heavy steamers and sailing vessels; while the second diameter thus set off, answers practically to the usual bow and stern in other vessels; thus leaving five diameters for the proper body of the vessel and the necessary machinery and storage.

7th. The armament of each steamer, I apprehend, should consist of *six traversing guns.* Two of these, of ten inches calibre, should be worked each on a strong pivot, placed on the line of the keel, at the distance severally of about one and a half or two diameters of the vessel from the stem and stern post. The four remaining guns, each of eight inches calibre, may be worked on like pivots, placed near the sides of the vessel, and as much nearer to the main shafts as will avoid interference with the two larger guns. When engaged with an enemy, *the line of fire should always, when practicable, be in the line of the keel.*

The above mentioned ordnance constitutes the armament of the recently constructed war steamers of England; and, so far as I can perceive, is the most appropriate and effective for a steam vessel: the peculiar vocation and advantages of which ought to be rapid motion and effective fire. In steamers of class D, or of *very* light draft, it may *possibly* be expedient to substitute 32 pounders for the four eight-inch Paixhan guns. But of the expediency of such substitution, I have strong doubts; and I hold it to be a waste of effort and resources, to arm a steamer or a ship for warfare at this day with ordnance of common weight and quality, or which is in any respect inferior to the heaviest and best which an enemy can present. Besides, the *lightest* steamer employed by us in war should be furnished with artillery suited for combat with the heaviest and most powerful ship afloat.

Perhaps some persons may entertain apprehensions of the inability of these light steam vessels to carry and sustain the action of the guns above mentioned. But these apprehensions are without any just foundations, as will appear from the following facts and considerations:

(1.) The points at which the guns are placed, require an access of weight equal to this armament, in order properly to equalize the load throughout the body of the vessel.

(2.) The weight merely of these guns is no more formidable or destructive to a vessel than a like concentrated weight of other heavy articles, of which vastly greater amounts are safely carried in all weathers on lighter decks than I propose for these vessels.

(3.) Owing to their large capacity, and their great superficial bearing upon the water, these vessels are better able to bear the addition of the above weight than any vessels now in the naval service. This may appear from the following facts: 1st, The average load-line area, or bearing superficies, of class C in the table, is nearly *three fifths* of that of the Brandywine frigate; while, if we allow 50,000 lbs. for the guns and carriages of the steam vessel, and 48,000 lbs. for the ammunition and other accessaries, it will then equal but *one-fifth* of the weight of the armament and its accessories of the Brandywine; and will require to sustain it only a draft of four and a half inches from the light load-line. Again, this average superficial bearing of the steam vessels is more than *four-ninths* that of the Ohio ship of the line: while the above weight of guns, ammunition, etc., is less than *one-eleventh* the weight of the military outfit of the Ohio. Once more, the average height of the *decks* of these steamers above the water at midships, exceeds *six feet,* with an average bearing surface

of near *seven and a half feet per ton* of the vessel and its contents. (See lines 12 and 30 of the table.) While the height of the port-sills of the Brandywine and Ohio are but *five and a half feet* above water, with an average bearing superficies of nearly *two and a half feet per ton.*

This shows an immense proportion in favor of these steamers, in the ability to carry accessory weight. Hence, this class of steamers may not only carry this armament, but, in addition, may also transport, when occasion requires, from five to eight hundred troops.

It may be well to notice here the apparent chances of this class of steam vessels when opposed to heavy war ships of the rates above mentioned.

1. *The choice of action* and position will always belong to the steamers. This is important when opposed to any force whatever; for the most favorable time and circumstances for combat may thus be commanded, or, if it should be proper and advantageous, the action may for the time be easily avoided. While, on the other hand, an equal or inferior force need not be allowed to escape.

2. *The target surface* presented by the Ohio when in chase, below the hammock rails, is probably equal to 1450 square feet; and in broadside about 5600 square feet. The cross area of the Brandywine presented in chase is probably equal to 940 feet, and that of her broadside area near 3800 feet; while the average cross area of the hulls of the steamers of class C exposed above water, to a height of seven feet above the deck, is only *three hundred and forty feet.* Now, as the steamers will probably engage chiefly at long shot, and *end on,* we may here perceive how great will be the advantage for the steamers, with equal skill in gunnery, whether or not a sufficient number of steamers to match the broadsides in weight, be taken into the account.

I say nothing here of the extraneous exposure of the wheels and smoke-pipes on one hand, nor of the spars and rigging of the ships on the other: believing that these chances, with proper precautions, are not unfavorable to the steamers.

3. From the great stability and superior steadiness of these steamers when in motion, particularly on the line of the keel, and from the accuracy with which they may be made to head *on or off* an object, by means of a marking point subtended above the bow, to guide the helmsman, they will afford to skilful gunners greater accuracy of fire than is usually obtained in ships, unless the latter be lying in smooth water.

4. In comparing the weight of metal opposed, if we reckon to the steamers the full weight which is due to the increased calibre of their guns, (and considering the greater destructiveness of shells to a ship, this appears not improper,) we shall find that four of these steamers, each with three guns engaged, will exceed, at each round, the weight of shot thrown by the broadside of the Brandywine; and that the fire of seven steamers will equal, in like manner, the broadside of the Ohio. While, in *chase,* there would be an overwhelming advantage in favor of the steamers.*

* In these estimates the weight of shot thrown by the broadside of the Ohio is

5. As regards the relative power of endurance, if shells are used, as they doubtless will be, this power in a vessel cannot be in proportion to the weight and massiveness of the structure; and may prove quite the contrary. But, if the form of model and position in action, which is here recommended, can be made efficacious in some degree for the protection of the engine and boilers below deck, which seems practicable, the steamers, with equal gunnery, must clearly have greater advantages for the endurance of fire in the aggregate than will belong to the ships. Besides, if we may estimate the aggregate power of endurance to be in proportion to the bearing area or superficial extent of the vessels, as appears not wholly improper, this advantage will be proportionally in favor of the steamers. Moreover, in shell-firing a single shot may prove fatal to a ship; while even a like result to one or more of its alert antagonists need not cause a discontinuance of the combat.

It might also have been suggested above, that as between ships and steam vessels the chances of the former rest only between victory and surrender; while with the latter they will ordinarily lie between victory and an easy escape. The chances, also, as between these active classes of steam vessels and the heavy steamers, or the broad and slow moving light steamers of an enemy, will partake much of the same character.

I propose now to notice the importance and necessity of the light and active classes of steam vessels for the naval service, and the purposes of national defence.

It has been well remarked by our naval historian, that "the first great object of the government should be to prevent blockades—its next, to employ vessels that cannot be blockaded."

However important it may be to maintain a powerful and well ordered navy, consisting of ships of the established classes, it can hardly be in our power, or within the scope of our policy, to maintain a numerical superiority as against England, even on our own coasts. And without such superiority, or at least a near equality, effectual blockades may not hereafter be prevented; to say nothing here of the chances of losing our ships and naval arsenals, by the onset of a powerful and well appointed expedition, supported by a numerous fleet of ships and war steamers.

With the aid of her numerous and heavy armed steam ships, England might effectually blockade not only our ships, but our war steamers of the heavy and medium classes. For our steamers of these classes could hardly put to sea, or return to port, in the face of a superior force of the same character; and it would be quite in vain to attempt gaining a superiority of this force by new constructions of like kind, for the present means of England, both mechanical and financial, are sufficient to outdo us in this effort, more than three to one. It is therefore indispensable to our superiority, that we should be prepared *with faster steamers, of lighter draft, and equal weight of metal, with those of England.* These steamers, being of the

taken at 1600 lbs., and that of the Brandywine at 864 lbs., as by advisement; and the shot of the eight and ten inch guns at 68 lbs. and 93 lbs. respectively.

classes which I propose, could never be blockaded in our ports by the existing naval means of any country. Moreover, if maintained in sufficient numbers, so as to be readily assembled in large squadrons at the points where the exigencies or demands of the service might require, the most powerful fleets would be unable to maintain a blockade, or to carry out with success a military expedition against our shores.

The same classes of steamers are also of essential importance on our frontier lakes, where armed steamers of the heavy classes and draft of water hitherto adopted, would be of greatly inferior value; and where all the strategetical advantages will be in favor of the classes proposed.

The greater value and adaptation of light built steam vessels, tenaciously constructed—not less in length and size, nor exceeding in weight and draft, the average of the classes C and D, may be now reviewed, or more summarily considered.*

I. Their facility of movement and surpassing speed, exceeding that of existing war steamers from three to six miles an hour, must necessarily afford, as above mentioned, the choice of action and position; and, excepting accidents, no enemy can either escape or overtake them, except at the will of their commanders.

II. Owing to the light draft of water and greater speed of these vessels, they may shelter themselves from a superior force in shoal positions, or attack and annoy the enemy from such positions on a vast extent of coast and inner waters, where heavy ships or steamers cannot approach. When the elaborate survey of our coast, now in progress, shall have been completed, and our officers shall also have become familiar with these shallow grounds by active coast service, in proper steam vessels, these facilities may become of great value.

The shoal inlets, bays and lagoons, of our sandy coast, from Nantucket to Texas, afford not only shelter but inexhaustible supplies of fuel for these steamers; and not only may these shores be thus protected from the assaults and incursions of an enemy, but regular cruisers may be constantly maintained from these inlets, by alternate portions of the squadrons thus assigned to the various points of our coast or the annoyance and capture of an enemy's navy or commerce.

III. By this means, not only may the exposed positions at Key West and other points be maintained in war, and made available for the annoyance of an enemy, but the strait of Florida, if not the other outlets of the Caribbean Sea and Gulf of Mexico, may be effectually and securely blockaded by squadrons of these steamers.

To illustrate this point more particularly, I beg leave to refer the Commissioners to the charts which are annexed.

It will be seen on the charts, that large portions of the Bahama Banks and other shoal grounds comprehending many hundred square miles, near the Florida strait, the Providence channel and elsewhere afford a depth of water which is barely sufficient for the navigation of these steamers, and will effectually exclude the heavier classes.

* I consider the Gladiator as being the proper type of the class D; except as being slightly deficient in length, which would be better at 200 feet.

This is particularly seen near Gun Cay light, and on the Florida reefs; where a squadron of these steamers may act securely, and attack or pick up everything that attempts to pass the strait of Florida, which can here be crossed by the steamers in about four hours. Nor is it seen how any existing naval force could dislodge such squadrons from these positions; from whence they might successfully assail not only the general commerce of the enemy, but his war steamers and other forces. Many secure positions are doubtless to be found on the opposite Florida reefs, and the banks not yet surveyed, as well as in some other parts of the West Indian Archipelago; while the coasts and inlets of Florida will afford supplies of fuel to any extent which may be desired. It is hoped that the enterprising officers, engaged in suppressing Indian hostilities, have well explored and noted the needful positions for these objects.

IV. By means of these active steam vessels, and a suitable and skillful force of Marines and Marine Artillery, trained for both land and sea service, which, I trust, may shortly be provided, an enemy's colonial posts may be captured, and his military resources laid under contribution. By like means, in case of a war with England, might the coal furnishing ports, and other outposts near our eastern frontier, be taken into our possession, and retained, or abandoned, as occasion might require.

V. It is chiefly by these means that we may expect to command, in such emergency, the more hazardous coasts of Maine, Nova Scotia, and the Gulf of St. Lawrence; thus cutting off the communications and military supplies of an enemy, and virtually blockading his American Colonies. On these rocky coasts, as elsewhere, any general degree of safety which might be supposed to result from solid built bottoms and heavy structures, may be far more than compensated by lightness of draft and tenacity of structure, and facility of movement; while in security against attack from a superior steam force, the heavy built steam vessels could maintain no equality with the light footed classes. The coast of Maine affords all necessary shelter and resources for this service; and this description of force, if matured by timely preparation, and put forth in our strength, might generally command the coasts and shores, from Quebec to Nantucket. Two or three vessels of the proposed class would doubtless prove more than a match for one of the heaviest English steam ships; and, for reasons already noted, the latter might find it difficult to escape.

VI. By proper arrangements, and, if needful, with the associated aid of one of the steam frigates, these lighter built steamers may be sent to any part of the world, where their services may be desired, and where friendly or neutral ports can be found to afford the necessary shelter and supplies of fuel. Their great speed and efficiency might thus be employed with great effect on an enemy's commerce and resources.

I have been led, by the request of the Commissioners, thus to explain, to some extent, my views on this essential branch of public defence, and to urge the adoption of a class of measures on which I consider the future safety of the country may largely depend; being ful

ly persuaded that it is not so much on the *magnitude*, as on the *available qualities* of our naval force, that we must rely for success in any future conflict with the great mistress of the seas.

I am, sir, with high respect,

Your obedient servant,

New York, January 25, 1842. Wm. C. Redfield.

REFERENCE TO PLATE 1.

Fig. 1.—Cross section of steamer near mid-ships. *c*,—Bilge strake *d*,—Engine bed. *e*,—Floor timber. *f*,—Keel. *g*,—Top timber. *h*,—Deck beam or carline. *i*,—Sponsing, if wanted.
Fig. 2.—Outside planking.
Fig. 3.—Section at *bb*, showing diagonal and interior side. *k*,—Deck plank. *l*,—Section of deck beam or carline. *m*,—Inside clamp. *n*,—Diagonal braces.
Fig. 4—Keelson and floor timber longitudinal section at *a*. *o*,—Section of keelson *p*,—Section of floor timber. *r*,—Bottom plank.
Fig. 5—Profile and view of a light war steamer. 6,—Deck plan. 7,—Water line.

Extracts from the Report of Napoleon Garella, *an Engineer appointed by the French Government to survey the Isthmus of Panama. Translated for the Journal of the Franklin Institute by* Persifor Frazer, Esq.

Topographical Configuration of the Isthmus of Panama.

This remarkable isthmus, which, uniting the two Americas, extends between the Gulf of Mexico and the Pacific Ocean, to a length of 2300 kilometres, (1430 miles,) in a direction from W. N. W. to E. S. E., presents along this enormous length a variable width. From the mouth of the Guazacoalco, its point of junction with North America, where it has a width of 220 kilometres, (137 miles,) it continues narrowing regularly enough, with the exception of the two large promontories of Yucatan and Central America, to its other extremity, towards the Gulf of Darien, where it is united to South America. It is towards this last portion, where it is called more particularly the Isthmus of Panama, that it attains its minimum width. From the town of Panama to Chagres, the distance in a straight line is but 65,470 metres, (40·68 miles:) from the mouth of the Caimito, on the Pacific Ocean, 22,000 metres, (13·68 miles:) west of Panama, to the embouchure of the Chagres on the Atlantic, the distance is but 58 kilometres, (36 miles;) but the minimum width appears to be a little more to the eastward, between the bay of Mandingo or San Blas, on the Caribbean sea, and the shore of the Pacific Ocean, near the embouchure of the Rio Chepo, where the distance, according to the map, is but 50 kilometres, (31·07 miles.) The chain of mountains which extends in a direction nearly north and south, the whole length of the two Americas, from the icy seas of the north pole, to Cape Horn, presents along nearly its whole length of 14,000 kilometres, (8700 miles,) a considerable elevation. Its peaks are only surpassed in height by the summits of the highest of the Himalayas, and even its vast plateaux have an elevation superior to that of the highest mountains of the interior of France. This chain extends, without any discontinuity, the whole length of the isthmus, but then as the breadth of the land diminishes, so the ridge of the chain sinks considerably, and presents some depressions, whose height above the ocean is less than that overcome by some of the European canals already con-

Fig. 5.

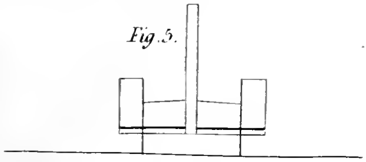


Fig. 4.

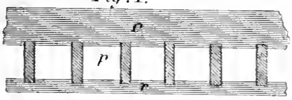


Fig. 2.

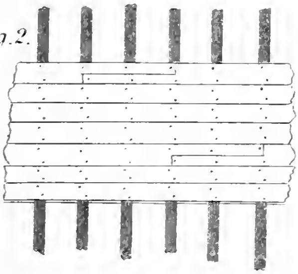


Fig. 3.

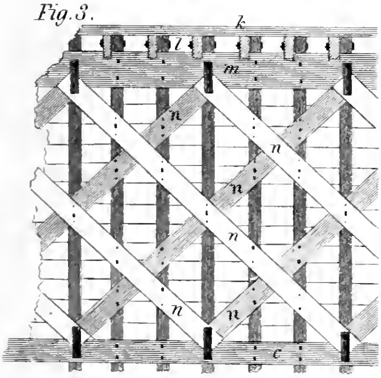


Fig. 6.

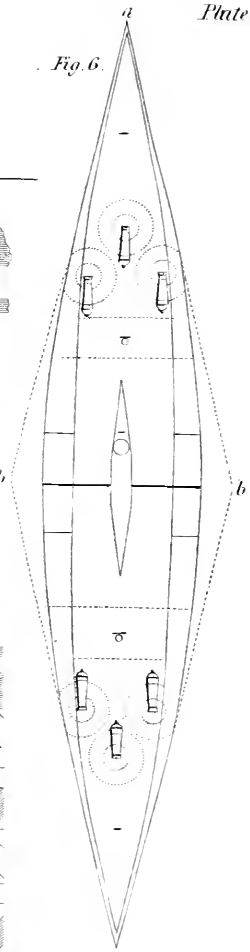


Fig. 7

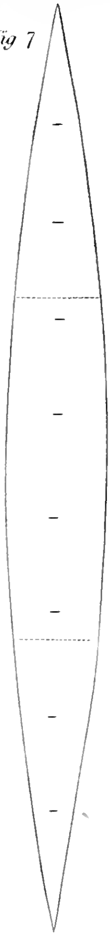
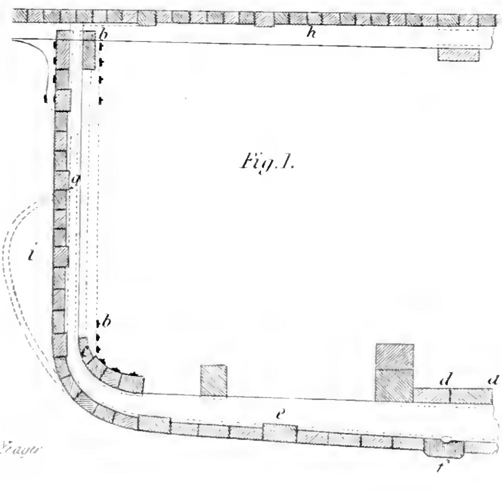


Fig. 1.



Eng by J. Yeager

structed. One of these remarkable depressions exists in the neighborhood of Panama—not at the point where the isthmus is narrowest, but a little to the westward, where, however, it is narrower than at Panama. In examining the configuration of the isthmus from west to east, it will be remarked that, passing from the state of Costa Rica (Central America,) into the province of Veraqua, (New Granada,) under the 85th degree of west longitude, 3 degrees to the westward of Panama, the central ridge dividing the waters flowing into the two oceans, retains a considerable height, relatively at least to the narrowness of its base; that it is continued at this height for a considerable distance; and that it appears to break off suddenly at the steep and precipitous peaks of the Trinity, (Cerro de la Trinidad,) situated 50 kilometres (31·07 miles) west of Panama, whose height may be estimated at from 12 to 15 hundred metres, (4 to 5 thousand feet.) There commences the depression of which I have spoken, and which extends a distance of 40,000 metres, (25 miles,) to the hills of Ormigueros, not far from the roads from Panama to Couces and Gorgona. The ridge then rises by degrees, and attains, opposite Porto Bello, and near the Gulf of San Blas, its previous height. Along this distance there are a number of points whose elevation varies from 130 to 160 metres, (425 to 525 feet,) between which the ridge rises but little, and forms hillocks, and not peaks or elevated masses. This depression of the central chain is, then, one of the first and most evident observations which the explorer makes; and it has been noticed by nearly all those who have surveyed the isthmus; Mr. Lloyd points it out for the line of a canal; and it is there, also, that Mr. Morel, the agent of the Salomon Company, has laid down his route. It is evidently there that the summit level of the maritime communication to be opened between the two oceans, should be placed. Unfortunately, those who have hitherto visited the isthmus, have only judged approximatively of the height of this portion of the chain, and that by a simple visual observation, made without employing any instrument, and mostly at long distances; and taking, without doubt, as points of comparison, the elevated mountains of the Trinity, and other masses of a considerable elevation, situated more to the eastward; those of the Cerro Cabra, which are 492 metres (1614 feet) high, and those of the Cerro Grande of Gorgona, which rise to a height of 310 metres, (1017 feet.) Thence, doubtlessly, comes the erroneous opinion spread abroad, on the faith of some navigators, that the central chain uniting the elevated table land of Mexico with the Andes of Peru, ceases entirely in the portion of the country of which we are now speaking; and is cut by a transversal valley, where man will have almost nothing to do to establish a navigable communication between the two oceans. Thence, also, without doubt, the extraordinary assertion advanced by the Salomon Company, that this depression of the chain offers a point of passage situated only 11·28 metres (37 feet) above the mean height of the sea at Panama, a point which the company naturally chose for carrying across the summit level of the canal which they projected. From the sides of the Cerro de la Trinidad flow three principal streams, of which the most important, the Caimi-

to, running at first parallel to the central chain from S. W. to N. E., turns at length to the right, towards the S. E., then towards the S., and empties itself into the Pacific, not far from the village of La Chorrera, 22 kilometres (14 miles) west of Panama, after having received as its principal tributary, the Bernardino. The two other streams, which flow towards the Atlantic, are the Caño Quebrado and the Rio Trinidad—rising at nearly the same point, they separate as they advance; the first flows parallel to the central chain and to the Caimito—the second runs nearly due north; they both empty themselves into the Rio Chagres, which descends from the elevated mountains situated to the east of the line joining Panama and Porto Bello, and flowing at first towards the south-west and west, at length turns towards the north-west, a little before receiving the Caño Quebrado, and empties itself into the Atlantic at the Port of Chagres, 27 kilometres (17 miles) below the junction of the Rio Trinidad. The Rio Trinidad has its mouth 15,000 metres (9·23 miles) in a straight line below that of the Caño Quebrado, and in the triangular space comprised between the two streams, the laws of nature, which, throughout America, have placed the ridge of separation of the waters flowing into the two oceans, nearer the western side, appears to have been maintained. The spur, in general of slight elevation, which separates the basin of the Trinidad from those of the Caño Quebrado and the Chagres, extends uniformly along the two last rivers, the effect of which is to augment considerably the former at the expense of the Caño Quebrado, which, consequently, is the channel of a much less considerable volume of water. The wide space which separates the bed of the Trinidad from the base of the spur, is occupied by vast and, for the most part, unbroken plains, from the middle of which rise some isolated hillocks. One does not there meet with the water courses which might be expected from their extent, but many swamps, and even deep lakes, communicating with the Rio Trinidad by small natural canals, called *esteros*. In these plains is found the large lake of *Vino tinto*, observed by Mr. Morel, which is upwards of a league in diameter. Here also are found, near the mouth of the river, the swamps of *Agua Clara*, which have in some places, as I have been assured, a depth of water of 12 metres (42·65 feet.)

Besides these streams, there is another on the western slope, flowing directly into the Pacific; it is the Rio Grande, situated between the Caimito and Panama, and having its mouth 2,000 metres (1¼ miles) west of that city. It is indeed a stream of no great magnitude, the upper portions of which are completely dry during some months of the year; but it presents a characteristic which it has in common with other affluents of the Pacific Ocean, which is, that the lower portion of its bed has but a slight descent and great width, so that the tide mounts it to a considerable distance, and thus forms an arm of the sea (estero) intruding into the land, with a depth varying from 8 to 10 metres, (25 to 33 feet,) and sometimes even more, which offers facilities for navigation, though only during high water, and as far as the tide flows. It is to this characteristic that the Rio Grande owes its name, though in fact it is but a brook. Along side of the Rio

Grande is another little ravine, pouring its waters directly into the sea. This is the Rio Farfan, having, towards its mouth, a wide and deep bed, which, at this point, is only separated from the Rio Grande by a hill, around which its waters are forced by high tides, flowing into the Alvine marshes, through which the road from Panama to Chorrera passes, thus mingling the waters of the two creeks.

This feature of a great diminution of fall near the embouchure of the stream, is still more perceptible on the Atlantic slope. The Chagres, which is undoubtedly the most important and most voluminous stream of water of this portion of the isthmus, presents it in a very striking manner. The tide of the Atlantic, which rises but from 34 to 40 centimetres, (13·38 to 15·75 inches,) ascends the river a distance of 28 kilometres (17·40 miles) from its mouth, above the point where it receives the Rio Trinidad. The Rio Chagres, according to a gauging made at Gorgona the 26th of March, 1844, at the period of the lowest water, above the Caño Quebrado and the Rio Trinidad, pours a minimum volume of water of 19 ·50 cub. m. (688·69 cubic feet) per second. In the lower part it is to all intents an arm of the sea; the current sometimes ascending, sometimes descending, is very feeble. Its width varies from 60 to 100 metres, (65 to 110 yards,) and the depth, which averages from 4 to 5 metres, (13 to 16½ feet,) increases at some points to 10 and 12 (32 and 40 feet.) This river, then, is navigable; but, nevertheless, with some difficulty beyond a distance of 30 kilometres (18·64 miles) from its mouth. Thence it can be ascended only by poling, on account of the rapidity of the current and the irregularity of the bottom. Laden boats ascend it as far as Gorgona and Crucés, but in the dry season (from December to June) they are obliged to unload the larger barques on a beach near the mouth of the Caño Quebrado, and to load again in smaller boats; and even with these they have great difficulty in reaching Crucés. In the rainy season, when the depth is sufficient, the current becomes so rapid that the ascent is made but slowly, and requires from 8 to 10 days for a distance of less than 80 kilometres, (49·70 miles.) With the exception of the Rio Chagres, the other rivers of the isthmus can hardly be said to be navigable. The Rio Trinidad above the point which the tide reaches, is but a rapid brook, (*ruisseau torrentill,*) which can be ascended a certain distance only when it is swollen by the rains, and then with great difficulty. The Caimito presents a great depth of water only in the vicinity of its mouth, and it is not possible to ascend either it or the Bernardino further than, or without the assistance of, the tide. It appears to me, then, that none of these water courses can be made useful for the purposes of navigation, except as far as the tide flows; and, moreover, in that case, there would be necessary, at least on the Pacific side, constructions for the especial purpose of confining the water and preventing the effects of the rise and fall of the tide, which is here very great.

At Panama, from observations made during my residence, the highest tides of the full and new moon of the equinox (6th and 21st of March, 1844,) are 6.10 m., (20 feet;) the lowest neap tides are 2 .75 m. (9·02 feet.) On the Atlantic they are but 35 to 40 centime-

tres, (13·38 to 15·75 inches.) This last variation in the level of the water is too trifling to be taken into account in the execution of a canal of communication, otherwise than in adopting the level of the lowest tides as the point of departure for the depth to be given to the canal.

The waters flowing from the central chain, at its point of depression, are divided, as we have seen, between two basins: that of the Caimito upon the Pacific slope, and that of the Rio Chagres, or rather of the Caño Quebrado, upon the Atlantic slope. I do not take into account that of the Rio Trinidad, because its sources, which are very close to the Cerro Trinidad, appear to be at too great a height to authorise us to seek there a point of passage. The first of these basins, which pours its waters directly into the sea, is bounded on the west by a spur of the Cerro Trinidad, terminating in the neighborhood of the village of *La Chorrera*, by round hills of no great elevation, and plains somewhat broken, from the middle of which rises the Cerro Gordo, a conical mountain entirely isolated, of about 100 metres (328 feet) in height. On the eastern side it is separated from the basin of the Rio Grande by an elevated spur, which, running off from the central chain at the Cerro Calderon, or neighborhood of the Ormigueros, loses itself in the mass of the Cerros de Cabra, the most elevated mountains of this portion of the isthmus. Its principal tributaries are the Rio Bernardino and the Rio Aguacato, which flows into the former. The second basin, that of the Caño Quebrado, which is itself but a principal tributary of the Rio Chagres, embraces about the same extent of the central chain. It is limited on the east side by a hill forming an abutment to the ridge of the Ormigueros.

It is then between the two basins of the Caimito and the Caño Quebrado, that the point for the passage of a canal of communication between the two oceans, is to be sought. It is along their tributaries that we must look for the valleys where the canal should pass; and finally, it is in the neighborhood of the localities where their waters empty into the sea, that is, near the mouths of the Caimito and the Chagres, that we must seek the points of communication of the canal itself with the two oceans; the bars which always form at the points where the running waters of rivers meet the still waters of the ocean, rendering it necessary, as a general rule, to avoid carrying a great line of navigation to those points.

The Rio Chagres has, in fact, at its mouth, a bar with a depth of water of but 4 metres, (13·12 feet,) much less than that found in the river itself, which cannot be passed by vessels drawing more than 3 .50 m. (11·50 feet) of water; those attaining that limit being able to pass it with difficulty, and only in fine weather. In the middle of the bar is a rocky shoal situated but 1 metre (3·28 feet) below the surface of the water, which narrows the pass to about 200 metres, (220 yards.) This bar, abutting on the eastern side against the high rocks, on which is built the fort of San Lorenzo, and at the foot of which flows the river, is united on the west to an extensive beach, which borders the isthmus for a long distance on the Atlantic coast. Under these circumstances, the insufficiency of such an en-

trance for an oceanic canal like that of which we are treating, may be easily comprehended; a canal which should admit ships of the greatest tonnage, and demanding at the least a draft of 7 metres (23 feet) of water. Doubtlessly it would not be impossible to remedy, at least temporarily, this defect; but the uncertainty, proved by experience, of the results of operations carried on at the mouths of rivers even larger than the Chagres, especially when they are for the purpose of opposing the accumulation of sand, should induce us to employ such means only in case it should be impossible to find another suitable entrance; here, however, nature herself appears to have provided one. 8,000 metres (5 miles) to the eastward of the Rio Chagres, is the large and capacious bay of Limon, which is 4,000 metres (2½ miles) in width, and 6,000 metres (3¾ miles) long. It has a great depth of water, which, in the centre, reaches 6 brasses, or 10 metres, (32·81 feet.) This bay is separated from the river by a tract of land in general of but slight elevation, and offering some low portions, which afford facilities for excavating a canal of communication with the river; works simple and easily constructed, will suffice for the establishment of a vast and sure port at the entrance of the canal, in the bay, which, opening to the north, is at present exposed directly to the action of the north, north-east and north-west winds, which reign almost constantly in these latitudes.

These disadvantages found at the embouchure of the Rio Chagres in the Atlantic, are still more apparent at that of the Rio Caimito in the Pacific. This embouchure is situated in the middle of a vast beach, which low water leaves uncovered to a distance of about 1,000 metres (1100 yards) from the shore; it thus unites a want of depth of water and the inconvenience of sand banks; the former may be remarked on nearly the whole of the coast from Panama to the Caimito, and at that city, on account of the great rise and fall of the tides, small vessels, such as brigs, of two to three hundred tons, drawing from 3½ to 4 metres (11½ to 13 feet) of water, are obliged to anchor off at a distance of 2,000 metres, (1¼ miles.) Sand banks are also found along nearly the whole coast, but more particularly at the bottom of the bays, and at the mouths of the streams. It is especially between Panama and the Cerros de Calva, that the want of a sufficient depth of water is observable. This defect is apparent from the great number of little islets which are seen at a certain distance from the coast, and which are surrounded by rocky shoals protruding above the water at low tide—amongst others the isle of Venados, which, at high tide, is 1200 metres (1300 yards) from the shore, is united to it by a ledge of rock which low water leaves bare. The number of these islets diminishes as you advance to the westward, and they disappear altogether opposite the mouth of the Caimito, leaving entirely free the arm of the sea separating it from the islands Taboga and Taboguilla, which are situated 11 kilometres (6·83 miles) from the coast, and where the largest vessels find an excellent anchorage. The coast does not offer in this neighborhood a favorable locality for a good port, with a sufficient depth of water, for to the depth of

water necessary for vessels must be added the height of the rise and fall of the tide.

But, fortunately, the neighborhood of the port of Taboga, and the almost constant tranquility of the Gulf of Panama, at the bottom of which is the mouth of the Caimito, permit us, in establishing the entrance of the canal, to take into consideration only the depth of water at high tide.

The place on the coast which appears to me the best to correspond with the required conditions in this respect, is a little bay with an opening of 350 metres, (382 yards.) and a depth of 200 metres, (218 yards,) situated 4,000 metres ($2\frac{1}{2}$ miles) to the eastward of the mouth of the Caimito, at the foot of the small mountain of Vaca de Monte, and to which, therefore, I have given the name of Ensenada de Vaca de Monte; it is bordered by rocks, and there flows in at the bottom of it a little stream of very trifling volume. At its entrance the mean depth was found to be 3 metres (9·84 feet) at the low tide of the 3d of July, 1844, (three days after the full moon,) which would give at least 8 metres ($26\frac{1}{4}$ feet) at high tide. There would be but little to do at this point to establish the entrance lock of the canal with such a depth of water that ships might enter, at least at high water, during the neap tides, about the first and last quarters of the moon.

(To be continued.)

Abstract or short Summary of Results from Experiments relative to the proposed Bridge across the Menai Straits, addressed to Robert Stephenson, Esq. By W. Fairbairn.

After a series of experiments undertaken at your request, for ascertaining the strongest form of a Sheet Iron Tubular Bridge across the Menai Straits, I have been induced, in order to meet the requirements for such a structure, and to ensure safety in the construction, to call in the aid and assistance of my friend Mr. Hodgkinson.

The flexible nature of the material, and the difficulties which presented themselves in retaining the lighter description of tubes in shape, gave exceedingly anomalous results; and having no formula on which dependence could be placed for the reduction of the experiments, I deemed it necessary, in a subject of such importance, to secure the co-operation of the first authority, in order to give confidence to the Chester and Holyhead Railway Company, with whom you are connected, and the public generally.

It will be observed, that the first class of experiments is upon cylindrical tubes;—the second upon those of the elliptical form;—and the last upon the rectangular kind. Tubes of each sort have been carefully tested, and the results recorded in the order in which they were made; and moreover, each specimen had direct reference to the intended Bridge, both as regards the length and thickness, as also the depth and width.

In the first class of experiments, which are those of the cylindrical form, the results are as follows:

Cylindrical Tubes.

No. of Experiments.	Distance between the supports.	Diameter in inches.	Thickness of Plate in inches.	Ultimate Deflection in inches.	Breaking weight in lbs.	Remarks.
	ft. in.					
1	17 0	12·18	·0408	·39	3,040	Crushed top.
2	17 0	12·00	·0370	·65	2,704	Ditto.
3	15 7½	12·40	·1310	1·29	11,440	Torn asunder at the bottom.
4	23 5	18·26	·0582	·56	6,400	Ditto.
5	23 5	17·68	·0631	·74	6,400	Ditto.
6	23 5	18·18	·1190	1·19	14,240	Ditto.
7	31 3¼	24·00	·0954	·63	9,760	Ditto.
8	31 3¼	24·30	·13501	·95	14,240	Ditto.
9	31 3¼	24·20	·0954	·74	10,880	Ditto.

With the exception of the first two, nearly the whole of the tubes were ruptured by tearing asunder at the bottom through the line of the rivets.

Finding the cylindrical form comparatively weak, the next experiments were upon tubes of the rectangular shape, which gave much better results. For the present it may, however, be more convenient to take the elliptical kind, as being the nearest approximation, as regards both form and strength, to the cylinders recorded above.

Elliptical Tubes.

No. of Experiments.	Distance between the supports.	Diameters, transverse and conjugate in inches.	Thickness of Plates in inches.	Ultimate Deflection in inches.	Breaking weight in lbs.	Remarks.
	ft. in.					
19	17 0	14·62 / 9·25	·0416	·62	2,100	Crushed on top.
20	24	21·66 / 13·50	1·1320	1·36	17,076	Broke by extension.
21	24 0	21·25 / 14·12	·0688	·45	7,270	By compression
22	18 6	12·00 / 7·50	·0775	·95	6,867	By compression. This tube had a fin on the top side.
24	17 6	15·00 / 9·75	·1430	1·39	15,000	Both sides were ruptured

It will be observed that the whole of these experiments indicated weakness on the top side of the tube, which, in almost every case, was greatly distorted by the force of compression acting in that direction. It is probable that those of the cylindrical form would have yielded in like manner, had the riveting at the joints been equally perfect on the lower side of the tube. This was not, however, the case, and hence arise the causes of rupture at that part.

The next experiments, and probably the more important, were those of the rectangular kind; they indicate a considerably increased strength when compared with the cylindrical and elliptical forms; and, considering the many advantages which they possess over every other yet experimented upon, I am inclined to think them not only the strongest but the best adapted (either as regards lightness or security) for the proposed bridge.

Rectangular Tubes.

No. of Experiments.	Distance between supports		Depth in inches.	Width in inches.	Thickness of Plate in inches.		Ultimate Deflection in inches.	Breaking Weight in lbs.	Remarks.
	ft.	in.			top.	bottom.			Broke by
14	17	6	9·6	9·6	·075	·075	1·10	3,738	Compression.
14	17	6	9·6	9·6	·272	·075	1·13	8,273	(Revers'd) Extens
15	17	6	9·6	9·6	·075	·142	0·94	3,788	Compression.
15	17	6	9·6	9·6	·142	·075	1·88	7,148	Extension.
16	17	6	18·25	9·25	·059	·149	0·93	6,812	Compression.
16	17	6	18·25	9·25	·149	·059	1·73	12,188	Ditto
17	24	0	15·00	2·25	·160	·160	2·66	17,600	Ditto.
18	18	0	13·25	7·50	·142	·142	1·71	13,680	Ditto.
23	18	6	13·00	8·00	·066	·066	1·19	8,812	Compression. Circular bottom, fin at top.
29	19	0	15·40	7·75	·230	·180	1·59	22,469	Sides distorted. Corrugated top

On consulting the above table, it will be found that the results, as respects strength, are of a higher order than those obtained from the cylindrical and elliptical tubes; and particularly those constructed with stronger plates on the top side, which, in almost every experiment where the thin side was uppermost, gave signs of weakness in that part. Some curious and interesting phenomena presented themselves in these experiments,—many of them are anomalous to our preconceived notions of the strength of materials,—and totally different to any thing yet exhibited in any previous research. It has invariably been observed, that in almost every experiment the tubes gave evidence of weakness in their powers of resistance on the top side, to the forces tending to crush them. This was strongly exemplified in experiments 14, 15, 16, &c., marked on the drawings and the table. With tubes of a rectangular shape, having the top side about double the thickness of the bottom, and the sides only half the thickness of the bottom, or one-fourth the thickness of the top, nearly double the strength was obtained. In experiment 14, (marked in the margin of the above table,) a tube of the rectangular form, 9½ inches square, with top and bottom plates of equal thickness, the breaking weight was 3,738 lbs.

Riveting a stronger plate on the top side,
the strength was increased to 8,273 lbs.

The difference being 4,535 lbs.,—considerably

more than double the strength sustained by the tube when the top and bottom sides were equal.

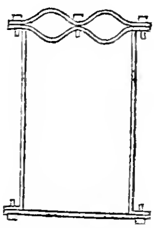
The experiments given in No. 15 are of the same character, where the top plate is as near as possible double the thickness of the bottom. In these experiments, the tube was first crippled by doubling up the thin plate on the top side, which was done with a weight of 3,788 lbs.

It was then reversed with the thick side upwards, and by this change the breaking weight was increased to 7,148

Making a difference of 3,360 lbs.

or an increase of nearly double the strength, by the simple operation of reversing the tube, and turning it upside down.

The same degree of importance is attached to a similar form, when the depth in the middle is double the width of the tube. From the experiments in No. 16, we deduce the same results in a tube where the depth is 18¼, and the breadth 9¼ inches. Loading this tube with 6,812 lbs. (the thin plate being uppermost,) it follows precisely the same law as before, and becomes wrinkled, with a hummoc rising on the top side so as to render it no longer safe to sustain the load. Take, however, the same tube, and reverse it with the thick plate upwards, and you not only straighten the part previously injured, but you increase the resisting powers from 6,812 lbs. to 12,188 lbs. Let us now examine the tube in the 29th experiment, where the top is composed of corrugated iron, as per sketch, forming two tubular cavities extending longitudinally along its upper side. This, it will be observed, presents the best form for resisting the "puckering," or crushing force, which, on almost every occasion, was present in the previous experiments. Having loaded the tube with increasing weights, it ultimately gave way by tearing the sides from the top and bottom plates, at nearly one and the same instant after the last weight, 22,469 lbs., was laid on.



The greatly increased strength indicated by this form of tube, is highly satisfactory, and provided these facts be duly appreciated in the construction of the bridge, they will, I have no doubt, lead to the balance of the two resisting forces of tension and compression.

The results here obtained are so essential to this enquiry, and to our knowledge of the strength of materials in general, that I have deemed it essential, in this abridged statement, to direct attention to facts of immense value in the proper and judicious application, as well as distribution, of the material in the proposed structure. Strength and lightness are desiderata of great importance,—and the circumstances above stated are well worthy the attention of the mathematician and engineer.

For the present we shall have to consider not only the due and perfect proportion of the top and bottom sides of the tube, but also the stiffening of the sides with those parts, in order to effect the required rigidity for retaining the whole in shape. These are considerations which require attention; and till further experiments are made,

and probably some of them upon a larger scale, it would be hazardous to pronounce anything definite as to the proportion of the parts, and the equalization of the forces tending to the derangement of the structure.

So far as our knowledge extends,—and judging from the experiments already completed,—I would venture to state that a tubular bridge can be constructed, of such powers and dimensions as will meet, with perfect security, the requirements of railway traffic across the Straits. The utmost care must, however, be observed in the construction, and probably a much greater quantity of material may be required than was originally contemplated, before the structure can be considered safe.

In this opinion Mr. Hodgkinson and myself seem to agree; and although suspension chains may be useful in the construction in the first instance, they would nevertheless be highly improper to depend upon as the principal support of the bridge. Under every circumstance, I am of opinion that the tubes should be made sufficiently strong to sustain not only their own weight, but in addition to that load, 2,000 tons equally distributed over the surface of the platform, a load ten times greater than they will ever be called upon to support. In fact, it should be a huge sheet iron hollow girder, of sufficient strength and stiffness to sustain those weights; and, provided the parts are well proportioned, and the plates properly riveted, you may strip off the chains, and leave it as a useful monument of the enterprise and energy of the age in which it was constructed.

In the pursuit of the experiments on the rectangular as well as other description of tubes, I have been most ably assisted by my excellent friend Mr. Hodgkinson; his scientific and mathematical attainments render him well qualified for such researches; and I feel myself indebted to him for the kind advice and valuable assistance which he has rendered in these and other investigations. I am also deeply indebted to yourself and the Directors for the confidence you have placed in my efforts, and for the encouragement I have uniformly received during the progressive development of this enquiry.

But, in fact, the subject is of such importance, and the responsibilities attached to it are so great, as to demand every effort to demonstrate, calculate and advise what in this case is best to be done. Both of us have therefore labored incessantly at the task, and I am indebted to my friend for the reduction of the experiments, which I would not attempt to weaken by a single observation.

Wm. Fairbairn.

Subject to be Continued.

Proceedings of the Institution of Civil Engineers. Extracted from the London Athenæum.

On the Incrustation of Steam Boilers. *By* W. West.—*February* 17, 1846.—The conclusion to which Mr. West arrived, as the best means of precaution against incrustation, was the selection of waters which, by analysis, were found to contain only soluble salts; or, in situations where bad water could alone be obtained, that the boiler should be frequently blown through, in order to get rid of the dense saturated part of the water, before the crust had time to be deposited.

In the discussion which ensued, Mr. Gooch stated that his attention had been called to a process invented by Dr. Ritterbandt for preventing incrustation in boilers. That process consisted simply in the addition of a small quantity of muriate of ammonia to the water in the boiler, and it had been found that this process not only effected the object proposed, but that it disintegrated and removed the incrustation already formed. Dr. Ritterbandt stated the results of his investigations; from which it appeared that carbonate of lime was the only substance which formed a solid incrustation; the other substances being merely mixed with, and cemented by the carbonate: that the muriate of ammonia acted as a solvent on the carbonate, converting it into the soluble muriate, without acting upon the boiler.

March 3.—The discussion upon the Incrustation of Boilers was renewed, and it was attempted to be shown, that, viewed chemically, the muriate of ammonia might act prejudicially upon the copper and iron of boilers; that the two metals in combination with a saline solution would induce a powerful galvanic effect, and, if aided by the unequal action of heat, producing a thermo-galvanic circuit, considerable deterioration of the boiler would ensue. It was instanced that, on applying a small quantity of the muriate of ammonia in a locomotive boiler, the incrustation was immediately removed from the tubes; hence it was argued, that a chemical action upon the metal must have taken place. On the other hand, after contesting the correctness of the chemical view assumed, it was asserted that, from the small quantity used, no perceptible chemical action could ensue; and that, in practice, after several severe trials of long duration, when the water was subjected to the most delicate tests, no traces of metal could be discovered. It appeared that the action of the muriate of ammonia upon the carbonate of lime forming the incrustation was merely to disintegrate it and render it soft and easy to be removed—for that after a given weight of incrustation had been boiled in a solution of muriate of ammonia for several hours, although it was rendered soft and pulverulent, the same weight still remained, thus proving that no sensible chemical combination had taken place. Numerous instances were given of the success of Dr. Ritterbandt's invention.

Description of the Dinting Vale Viaduct on the line of the Sheffield and Manchester Railway. By A. S. Jee.—*Feb.* 24.—This viaduct consists of sixteen arches, five of which are of timber, and eleven of brick; the whole of the large piers, wings, outside spandrils and parapets, are built of stone. The five large arches, which are each of 125 feet span and 25 feet versed sine, are built of Memel timber; the main ribs of these arches are composed of planking three inches thick, bent and laid longitudinally and fastened together with oak trenails, and firmly stayed by means of wrought iron tie-rods. The smaller semicircular arches, situated at each end of the viaduct, are built of brick with stone quoins. They are of 50 feet in the span and 3 feet in thickness, and are built in a curve of 40 chains radius, the pins being wedge-shaped to suit the curve, leaving the faces parallel with each other. The entire cost of the viaduct (which was given in its various details in the paper) was stated to be 35,250*l.* 6*s.* 5*d.*, its total length 484 yards, and its greatest height about 125 feet above the water course. It was commenced early in 1843, and was opened in August 1844. The average cost of construction was calculated to be about 2*l.* 14*s.* per superficial yard, and 6*s.* 9*d.* per cubic yard, the viaduct being 8 yards wide.

System of Preparing the Transverse Sleepers and fastening the Rails upon them; invented by Sir John McNeill, *and employed on the Dublin and Drogheda Railway.—Feb.* 24.—The sleepers are half baulks, 12 inches by 6 inches at the junction of the rails, and intermediately half trees of larch with the bark on, not less than 8 inches by 4 inches, are placed with the round side upwards, at an average distance of 2 feet 6 inches apart. These sleepers are prepared for bearing the rails by fixing twelve at a time on a sliding table similar to that of a plaining machine; they are moved forward by steam power beneath two circular cutters, set at the given distance of the gauge apart, revolving very rapidly, and which pass through the whole series of sleepers cutting at a given inclination the seats for the rails. A slight stoppage of the table takes place as each sleeper is cut, in order to afford time for four drills to descend simultaneously and to pierce the holes for the pins or trenails for holding down the rails. An engine of six-horse power suffices for working two of these machines, by which one thousand sleepers can be finished complete in twenty-four hours, at an expense of about one penny each, instead of twopence halfpenny each, which they formerly cost by manual labor. The sleepers thus prepared are used transversely beneath rails of the bridge, of which the sides are slightly pinched inwards in finishing, so as to form a dovetail, with a joint plate with a raised rib, which is laid at each junction, and which, by using a screw-pin and plate at one end and a collar-headed pin at the other, holds the rail very fast, preventing lateral and vertical motion, but permitting longitudinal action in expansion and contraction. These rails weigh 83lb. per yard. The total cost per mile of the double line, including rails, sleepers, pins, spikes, joint chairs, &c., laid complete, is stated at 3,470*l.* 2*s.* 8*d.*, when the rails cost 7*l.* 5*s.* per ton.

On the subject of the permanent way of the Dublin and Drogheda Railway, it was argued that although, if taken at weight for weight, there could be no doubt of the superior strength of the double T shaped rail over the bridge-shaped rail, yet that in practice the traveling on the Dublin and Drogheda Railway was remarkably smooth and equable; which, it was contended, resulted from the firmness of the attachment of the bridge rail direct upon the sleepers, and from the general perfection of the laying of the line. On the other hand, it was shown that a lighter double T shaped rail, with good cast-iron chairs and wooden trenails for fastenings, and fixed upon triangular sleepers, as on the South-Eastern, would, if the same machinery had been used in the preparation, and the same attention given to the laying down, have produced a better line. It was admitted, that the great points in establishing a railway, were to have heavier rails and stronger chairs, laid with accuracy, and constantly attended to; but that even then, unless the carriages were well constructed and adapted for their load, no smoothness or uniformity could be insured.

An Account of the Drops used for the Shipment of Coals at Middlesborough-on-Tees, with a description of the Town and Port. By G. TURNBULL.—*March* 10.—The communication first gave an account of the town; and then described the docks, and the coal-drops used there. The rapid rise of the town into commercial importance was accounted for, chiefly by the fact of a branch having been constructed, from the Stockton and Darlington Railway, to Middlesborough, which, as a port for shipping, possessed advantages over Stockton. The approach to the dock was stated to be by a channel of more than a quarter of a mile in length, which was kept open by sluicing; the entrance lock, built of stone, was 132 feet long by 30 feet wide, and the area of the dock itself was about 9 acres. The branch railway diverges from the Stockton and Darlington line, and terminates in ten double lines, leading to the ten coal-drops. The manner of working the drops was thus described: the loaded wagon is run on to a cradle or stage, which is arrested in a position immediately over the hatchway of the vessel to be loaded; it is then let down perpendicularly by means of counterbalance weights, and when it has nearly reached the deck, the contents are discharged into the hold; the counterbalance weights then preponderate, and the wagon is raised. About thirty wagons can be discharged an hour by each drop. In a statement annexed it is mentioned that in the year ending July 1, 1845, 505,486 tons were shipped by means of the ten drops. The cost of the drops was 7,300*l.*; the total outlay for the whole works amounted to 122,000*l.*

FRANKLIN INSTITUTE.

Committee on Science and the Arts.

Report on Cut-off Valves, by Cook & Seckel, and by R. L. Stevens.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred an application from the Hon. Robert J. Walker, Secretary of the Treasury of the United States, for their opinion as to the comparative merits of the Cut-off Valves of Mr. R. L. Stevens, and those of Messrs. Cook & Seckel, Report:—

That they have examined the construction of the valves of the parties named, on board of the steamboats New Philadelphia, in the Delaware, and Transport, at New York, and on board the Balloon, in the Delaware, and the Rhode Island, running between New York and Stonington; and are enabled to give such descriptions of them as will, they hope, render their construction intelligible to every one interested in the question.

The cut-off apparatus of Mr. Stevens, examined on board the New Philadelphia and elsewhere, consists of an eccentric, with a frame rod, connecting it with a lever on a rock-shaft, by means of a wrist pin; upon which rock-shaft there are lifters, or "wipers," as they have been termed, which raise the valve rods, and thus lift, by means of arms, the induction valves. The lifters or wipers are longer, and project further out than the lifters of ordinary valves; when in motion they raise the induction valves quicker than the ordinary lifters, and also close them more rapidly. The lever of the rock-shaft is constructed with a slot, in which the wrist pin is secured by a screw nut and washer, by means of which the distance or height of the lift may be adjusted. The frame rod from the eccentric may be lifted off of the wrist pin upon which it rests, by a hook in the usual manner, so that its connexion with the induction valve may be removed at will, and the engine thus brought under the action of the hand gearing.

In the arrangement examined by the committee on board of the New Philadelphia, the parts are fixed and imperative, with the exception of the ability to detach, as mentioned above, unless the engine be stopped, when all the parts can be set, so as to adjust the cut-off to any point.

The committee have seen the improvements which have been made, and are now in use, on board the Transport; they are of the following character:—In the first place, a screw has been added whose motion is in the direction of the slot in the lever of the rock-shaft, by means of which the amount of lift may be altered, whilst the engine is in motion; in the second place, by an arrangement of set screws attached to the lifters, by which they may be adjusted in like manner; and, lastly, by other means of adjustment consequent to the foregoing, so that the whole may be altered successively, without the necessity of stopping the engine.

The last means of adjustment referred to in the foregoing paragraph, is the shifting of the eccentric so as to change the *time*, or *lead*, as the case may be; plans have been exhibited to the committee by which this result may be accomplished, and evidence has been laid before them, that such change has been effected, during motion; but the committee are not satisfied that it can be done with safety or certainty in all cases, and are under the impression that it will be attended with great difficulty, where there is rapid motion. These means of adjustment have the disadvantage consequent upon loose parts, in their liability to derangement, of which the following is an enumeration: movable fittings in the lifters; in the wrist pin, which must move in its slot, and a loose eccentric, the failure of any one of which must stop the engine.

The committee have no reason to doubt the practicability of the changes required, and do not hesitate to state their conviction that the apparatus may be brought under the entire control of the engineer, with the exception in regard to the eccentric, before mentioned.

On board of the Balloon and the Rhode Island, the committee had good opportunities of seeing the cut-off apparatus of Messrs. Cook & Seckel, which they will now proceed to describe.

It consists of slide latches, moving upon the lifting arms of the valve rods, which are kept forward by spiral springs; these latches (which are forked so as to embrace the stems of the valves) pass under two long lugs, as they may be termed, placed one on each side of the valve stem, so that the valve is lifted to the desired extent by the slide and arm, when the former is drawn back, permitting the valve to fall to its seat, the stem passing freely through the arm from the lifting rod. The outer or back end of the forked slide is furnished with a mortise, through which an upright passes; upon the extremity of the upright there is an inclined plane or wedge; this last described part is secured to the steam pipes or chest, by screw fixtures.

The action of this arrangement is as follows:—As the rod rises with the valve, the slide first mentioned touches the inclined plane of the upright, and is drawn back by it, so as to liberate the lugs on the valve, when the valve falls to its seat. The screw fixtures of the upright are capable of adjustment or removal, so that the valve may be set to cut off, or work, whole stroke, at any time. As the valve falls not only by its own weight, but aided by the pressure of the steam, an arrangement is appended to modify the shock or jar, from the sudden fall of the valve, called, technically, a *Dashpot*, consisting of a cavity of a size adapted to receive a disk or plunger upon the end of the valve stem, with a sufficient space to allow water, with which it is filled, to escape gradually, so as to ease off the fall of the valve.

The Balloon is furnished with an arrangement as above described, attached to the upper and lower induction valves, requiring separate adjustments for the cut-off upon opposite ends of the cylinder. The committee is informed that a connecting rod, with a single adjustment, had been contrived, by which both valves could be controlled

at the same time, either as to the adjustment of the cut-off, or its removal, without interrupting the play of the engine.

It has been represented to the committee that the foregoing description of the cut-off on board the Balloon, is not the avowed arrangement of Messrs. Cook & Seckel, but they are satisfied that it is the same in principle and mode of operation, differing only in the form and arrangement of the parts—so that the description as given is substantially applicable in all respects. On board the Rhode Island the Dashpot apparatus is placed above, and there are other differences of construction; but, as above remarked, the result which is arrived at is the same.

The committee, after mature consideration, are of opinion, that these different modes of cutting off the steam in engines worked expansively, have, severally, advantages peculiar to each, and disadvantages inseparable also from them, which will be briefly stated in illustration of their views of the question submitted to their judgment.

Stevens' cut-off has the advantage of construction, in permitting an unlimited lead to be given to the exhaust, so that the engine can be prepared for the efficient action of the steam on its admission, and by which, accidents from condensation in the cylinder can be avoided. This arrangement also permits the steam to be cut off at any point from the commencement to the termination of the stroke.

Its disadvantages are confined to the complexity arising from the necessity of a separate eccentric, rod, rocking-shaft, &c., and to the additional weight and space which these parts call for in construction. The cut-off cannot be exactly the same on both ends of the cylinder, the arcs described being different when the eccentric is upon opposite sides of the shaft. They believe, also, notwithstanding the assurances of parties who have been consulted, that considerable difficulty will be found in altering the cut-off, whilst the engine is in motion, especially as a change in the position of the eccentric is essential.

The cut-off apparatus of Messrs. Cook & Seckel has a decided advantage in its simplicity and economy of construction: it admits, with facility, of change or removal, during the motion of the engine. It has the advantage of rapid action, the cut-off being nearly instantaneous.

In the form in which the committee inspected the apparatus, its operation was confined to some point less than half stroke; they are satisfied, however, that it is not limited to this extent, but may be made to cut off at nearly all points, by apparatus, not complex to an excessive degree, and not such as to change in a material manner its general features; lastly, if any part should fail, it may be detached, and the engine worked at whole stroke.

Its disadvantages are confined to the inability to give more than a limited lead to the exhaust, which is therefore not so fully under the control of the engineer as that of its rival, and to the fact, that there is a time at and near the change of motion of the lifter, presenting difficulty in the cut-off at and near half stroke.

The committee, under the influence of these views, have some embarrassment in giving a decided preference to either of these arrange-

ments; they have no doubt that both of them are capable of operating efficaciously, but a comparative estimate of the advantages and disadvantages of each, have led to the conclusion that neither has merits that could be determined, to the exclusion of the other, in a perfectly satisfactory manner, without a sea voyage, under similar circumstances in all respects, or which had not stood the test of time and service with competent and impartial engineers.

By order of the Committee,

William Hamilton, Actuary.

Philadelphia, April 9, 1846.

Report on Parker's Water Wheel.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination a Water Wheel invented by Zebulon Parker, of Newark, Licking county, Ohio, Report:—

That the wheel of Mr. Parker, secured by patents of October 1829, (Journal of the Franklin Institute, 2nd Series, Vol. v, p. 33,) and June 1840, (Ibid. 3rd Series, Vol. ii, p. 135,) consists of an annular space included between two concentric cylinders, and closed above and below. This space is divided into compartments by means of curved partitions or paddles, against which the water acts to turn the wheel. The wheel is mounted upon an axis either vertical or horizontal, and the water is introduced into the interior, by means of a spiral inclined plane or helix, by which it is delivered at the inner circumference of the wheel very nearly in the direction of the tangent to its motion. The curve of the buckets is so laid down, that the water issues from the external circumference, with no more velocity than that necessary to clear it from the wheel.

The whole wheel and its helical sluice are introduced into an air-tight box, called by Mr. Parker 'a draft,' or 'draft-box,' which is kept perfectly tight by being immersed in the penstock, and into which water can find admission only by passing through the wheel; proper arrangements are made for carrying off the water as fast as it is delivered by the wheel.

For a more detailed description of the wheel, the committee refer to the descriptions in the patents above cited, and to the models and drawings with which Mr. Parker has furnished the Institute.

A very slight examination of these descriptions, models and drawings, will show that Mr. Parker's wheel is a true wheel of pressure, or 'turbine,' in which the helical sluice has been substituted for the curved guide placed by M. Fourneyron in the interior of his wheel; it might therefore be expected that, provided the curved paddles of the wheel be properly constructed, the practical coefficient would approach, at least, that given by the ordinary turbine; and the experiments tried by your committee have satisfied them that this is in fact the case.

Mr. Parker himself, in a letter addressed to the Actuary of the Institute, has explained the advantages which he expected to gain by the introduction of the draft-box, and these are evidently great enough to be secured, even at the sacrifice of some of the power of the machine. "By this arrangement (the introduction of the draft-box into the penstock) we are enabled to place the wheel at any convenient height within the compass of the head and fall, and still have the whole descent of water operate upon it. In some instances of saw-mills of 17 and 18 feet head and fall, the axis of the wheel (which is horizontal) has been placed 8 feet above the surface of the lower level, and the power of the mill appeared in every instance to be the same that it would have been if the wheel had been placed at the bottom of the whole descent. This is often a great convenience, as the wheel may be placed in a situation in which it can be but little impeded by the rise of large streams, and frequently reduces the pitman to a proper length, which otherwise would have to be made so long that it would vibrate or tremble. Another important advantage of this arrangement is, that the wood work necessary for the wheel being submerged, cannot be injured by the changes of the air, and will consequently be very durable; and the wheel is effectually secured from frost in the coldest weather."

While, however, the committee acknowledge the advantages to be thus gained, (and another may be added to them, viz., facility of access at any time to the bottom of the wheel for examination or repair,) they believe that the maximum of useful effect, other things being the same, will always be found by placing the wheel as nearly as may be on the level of the water in the tail-race, so as to suffer as great a column of the water as possible to act directly by its pressure upon the wheel.

In reference to the experiments the committee regret, that in consequence of the distances from the city of the places at which Mr. Parker's wheels were established, and in consequence of the other occupations of the members of the sub-committee, and of Mr. Parker himself, there has been no opportunity to arrange and execute a complete and satisfactory set of observations upon a good wheel. The circumstances under which the experiments have been tried, have been in every case unfavorable to the wheel, and it is not believed that the results which they show, are in any case equal to the maximum useful effect to be obtained from the wheel when properly established and working under favorable circumstances; yet as they establish the decided excellence of the wheel, and as it is not probable that they can be extended or repeated, for some time at least, the committee report the results.

The useful effect of the wheel was tested by the application of Prony's friction dynamometer, an instrument which furnishes the most speedy, convenient and accurate measurement of the power conveyed to the axle upon which it is established, and of which a description will be found in the Journal of the Institute, (3rd Series, Vol. v, p. 225.) The number of revolutions of the wheel was counted by means of a dial connected with a spur-wheel, operated on by

an endless screw placed upon the axis of the wheel, but so arranged that it could at any moment be thrown out of adjustment, or re-adjusted, at the pleasure of the operator. The disk rotates under an index, which can either be allowed to revolve with the disk, or by the pressure of the finger upon its axis be stopped, and suffer the disk to revolve under it without partaking of its motion. This arrangement, which was devised and executed by Mr. Parker, furnishes a very easy and very accurate method of counting the revolutions of the wheel.

For the purpose of measuring the quantity of water which passed the wheel in a given time, the committee made use of a plan also devised and executed by Mr. Parker, which appears to be the simplest and best yet proposed for estimating the water.

A waste-board was established in the tail-race, sufficiently far from the mill to be out of reach of any commotion which might be excited in the water by the wheel, yet near enough to be perfectly under the inspection of the committee; (the wheel under consideration delivers its water so quietly, that the waste-board may be established within a few feet of it.) In this waste-board was cut a rectangular notch, with square sharp edges, having a length sufficient to pass a given number of cubic feet per minute, (greater than the maximum expenditure of the wheel,) with a given depth of water over the bottom of the notch. This notch might be closed water-tight by a sliding board which was so graduated as to read off the number of feet which could pass the opening, with a given length of notch, under the fixed height of the water. This fixed height was maintained by means of two boards projecting at right angles from the waste-board, sufficiently far towards the wheels to reach that part of the tail-race, the level of the water in which was not affected by the fall over the notch of the waste-board. As these boards included between them and the sides of the tail-race, a space in which the water was tranquil, the true level of the water in the tail-race was thus brought down to the waste-board, and by adjusting the slider until the water rose exactly to the level of the upper edges of the projecting pieces, (which were made perfectly horizontal,) the proper depth over the bottom of the notch was accurately preserved. The accuracy of the adjustments and graduating was first fully ascertained. The difference of level between the water in the head and tail-race was measured by means of a float with a graduated stem, and was carefully watched during the experiment.

The following tables exhibit the results of the experiments:—

TABLE FIRST.

Experiments upon a Wheel 36 *inches in diameter; the aggregate openings for the issue of the water amounting to* 150 *sq. inches; axis vertical; established at Mr. Bancroft's Woollen Factory on Ridley Creek, Delaware county,* 11*th December,* 1845.

No. of Experiment.	POWER EXPENDED.				EFFECT PRODUCED.				
	Fall of water in feet & 10ths $=h$.	Cubic ft. per minute	Lbs. of water per minute. $=w$.	Actual power of water. $h \times w = p$.	Weight on lever. $=w$	Revolutions per minute. $=v$.	Effective force of wheel. $w' \times v \times 50 = f$.	Ratio or Practical co-efficient. $=\frac{f}{p}$	
1	7·18	1172	73250	525937	0.	225·25	0.	0.	
2	7·248	1020	63750	462060	31·5	154·33	243069·75	·526	
3	7·265	980	61250	444881·25	36	144·25	259650	·584	
4	7·29	940	58750	428287·50	45	120	270000	·630	
5	7·30	920	57500	419750	50	106	275000	·655	
6	7·31	900	56250	411267·50	54	99	267300	·650	·6519
7	7·31	890	55625	406618·75	54	98	264600	·6507	
8	7·32	880	55000	402600	57	89·50	254975	·633	
9	7·325	875	54687·50	400586	57	88	250800	·626	
10	7·33	870	54375	398568·75	61	80	244000	·612	
11	7·34	854·5	53406·25	392001·875	65	71	230750	·589	
12	7·345	850	53125	390203·125	69	65·50	225975	·579	
13	7·35	834	52125	383118·75	74·5	51	189975	·496	
14	7·355	825	51562·50	379242·19	76	43·25	164350	·433	
15	7·358	825	51562·50	379396·875	79	43·50	171825	·453	
16	7·36	810	50625	372600	81	35·50	123727·50	·332	
17	7·36	793	49562·50	364780	86	0.	0.	0.	

The mean of the experiments at working velocities with this wheel is ·6519: the quantity of water discharged per minute varying from 890 to 920 (mean 903) cubic feet: the difference of levels of the water in the head and tail-race 7·3 feet: the load upon the end of the brake lever from 50 to 54 (average 53) pounds: the circumference described by the end of the brake lever 50 feet: the number of revolutions per minute from 98 to 106, (mean 101.)

This wheel was not erected under Mr. Parker's personal superintendence, and an error had been committed by giving too steep a slope to the helical sluice, which materially diminished the good effect of the wheel; when this has been remedied, it will be interesting to have the experiments upon this wheel repeated.

TABLE SECOND.

Wheel established for driving the Cotton Factory of the New Brunswick Manufacturing Company. Wheel 40 *inches in diameter; aggregate openings* 200 *sq. inches; axis vertical; May* 9*th*, 1846.

	POWER EXPENDED.				EFFECT PRODUCED.				
No. of Experi't.	Fall of water. $=h$	Cubic feet per minute.	Lbs. of water per minute; 62½ lbs. per cub. foot. $=w$	Actual power of water. $h \times w = p$.	Weight on brake lever. $=w'$	Revolutions of wheel per minute. $=v$.	Effective force of wheel. $w' \times v \times 50 = f$.	Ratio or Practical co-efficient. $=\frac{f}{p}$	
1	10·04	1056·5	66031	662951	36·5	138	251850	·380	
2	10·025	1190	74375	745609	42	144	302400	·406	
3	10·07	1324	82750	833292	124	73	452600	·543	
4	9·935	1347·5	84219	836716	115	85	488750	·584	
5	10·00	1356·5	84781	847810	107	90	481500	·568	
6	10·055	1386	86625	871014	102	107	545700	·626	
7	9·97	1392	87000	867390	103	107	551050	·635	
8	9·995	1407	87937	878935	96	116	556800	·634	
9	9·74	1362	85125	829117	95	107	508250	·613	
10	10·03	1382	86375	866341	95	111	527250	·609	
11	9·90	1407	87937	870581	90	120	540000	·620	
12	9·955	1427	89187	887862	85	126	535500	·603	
13	9·998	1338	83625	836083	105	98	514500	·615	
14	9·87	1330	83125	820444	110	90	495000	·603	0·615
15	9·815	1282	80125	786427	115	85	488750	·621	
16	10·005	1345·5	84094	841360	110	90	495000	·588	
17	9·83	1357	84812	833707	105	96	504000	.605	
18	9·995	1378	86125	860819	100	106	530000	·616	
19	9·92	1392·25	87016	863199	95	116	551000	·638	
20	9·96	1480·75	92·547	921768	90	124	558000	·605	
21	9·755	1834	114625	1118167	0	270	0	0	

These experiments were tried under very disadvantageous circumstances. The brake was established upon a shaft only 4½ inches in diameter, and the friction blocks were 3 feet long, and made of oak, with the grain running parallel to the shaft; the action was, consequently, very irregular. Moreover, the brake was not applied to the shaft upon which the wheel was placed, but to one connected with it by means of two spur wheels of large diameter; and passing nearly to the fourth story of the mill, supported by four bearings which had not been oiled for some time.

Mean of 15 experiments—with velocities varying from 85 to 126 revolutions per minute; loads upon the lever (the circumference described by whose end was 50 feet) varying from 85 to 115 lbs.; the quantity of water discharged per minute from 1282 to 1481 cub. feet; difference of the level of the water in the head and tail-race from 9·74 to 10·005 feet,—0·615.

TABLE THIRD.

The cotton factory at New Brunswick is driven by two wheels of different dimensions. The last set of experiments were tried with the larger wheel, the following were tried with the smaller.

Experiments with Wheel 36½ *inches diameter; aggregate openings* 150 *sq. inches; axis vertical. May* 22*d*, 1846.

	POWER EXPENDED.			EFFECT PRODUCED.				
No. of Experi't.	Fall of water. $=h$.	Cubic ft. of water per minute $=q$.	Actual power of water. $=p$. $=h \times q \times 62{\cdot}5$	Weight on lever. $=w'$	Revolutions per minute. $=v$.	Effective force of wheel. $=w' \times v \times 50$ $=f$	Ratio or practical coefficient. $=\frac{f}{p}$	
1	9·95	1348·25	838430·47	18	252	226800	·27000	
2	9·977	1306·75	814835	25	235	293750	·36000	
3	9·94	1278	793937·50	30	222	333000	·41565	
4	9·96	1257	783281·50	35	217	379750	·48482	
5	10·042	1234	774500	40	207	414000	·53454	
6	9·99	1206	753000	45	194	436500	·57968	
7	10·01	1174	734468·80	50	180	450000	·61269	
8	10·08	1149	723875	55	170	467500	·64613	·676
9	10·10	1110	700687·50	60	166	498000	·71073	
10	10·06	1127·50	708937·75	60	156	463600	·66000	
11	9·92	1054	653500	65	142	461500	·70620	
12	9·89	1072	662625	66	132	435600	·65739	
13	9·91	1049	649718·75	72	124	434000	·67600	

The mean coefficient determined by six experiments upon this wheel—with velocities varying from 124 to 170 revolutions per minute; load on the brake lever, (of the same length as in the last experiments,) from 55 to 72 lbs.; the quantity of water discharged per minute from 1049 to 1149 cubic feet; the difference of levels of the water in the head and tail-race from 9·89 to 10·1 feet,—0·676.

It was found impossible to carry the experiments beyond 72 lbs. upon the brake lever, which gave 124 revolutions per minute, although this was a speed materially greater than that for which the wheel was calculated. If the lever was loaded above this, rapid vibrations ensued, and the wheel suddenly stopped. Upon a subsequent examination this was found by Mr. Parker to be owing to the upper bearing of the wheel, within the penstock, (the arrangement being merely a temporary one,) having been made of wood, which, swelling by immersion in water, had subjected the wheel to a resistance, which could not be estimated. As this must have been in action during the whole of the latter part of the experiments, that is, during the experiments at working velocities, it is evident that the useful effect of this wheel must be greater than is indicated by the coefficient obtained in the experiments.

In conclusion, the committee regret exceedingly the incompleteness of their experiments, which has been caused by the impossibility of

devoting the necessary time and attention to their preparation; but, as circumstances render a report without farther delay desirable, they submit them as they are, and recommend the wheel of Mr. Parker to the attention of mill owners, as possessing the following advantages:

1. In regard to its useful effect it ranks with the overshot water wheel and turbine.
2. It possesses the peculiar advantages of the turbine, in reference to the action upon it of back-water or ice, and, like it, can be established either upon high or low falls.
3. It is simple in its construction, and of durable materials, and is for these reasons not expensive, and not liable to get out of order.
4. From its peculiar adjustment, easy access may be had to it at any time for the purpose of inspection or repair.
5. Running at high velocities, no intermediate gearing will be necessary, where such velocities are desirable.

By order of the Committee,

William Hamilton, Actuary.

Philadelphia, June 11, 1846.

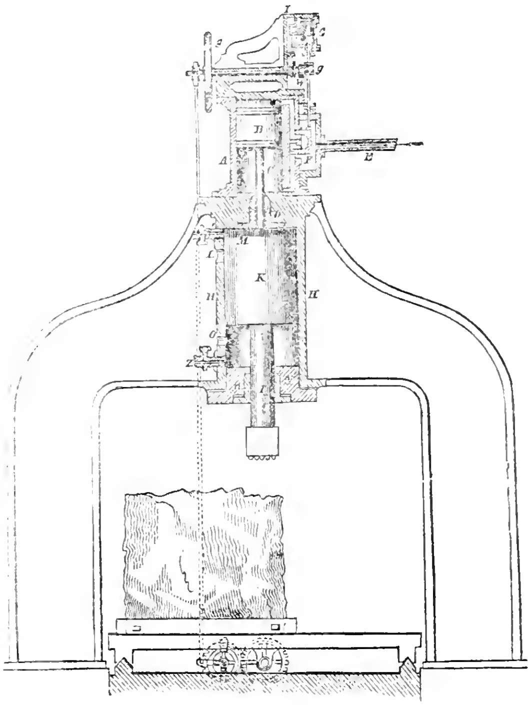
SPECIFICATIONS OF ENGLISH PATENTS.

Specification of a Patent granted to James Nasmyth, *of Patricroft, in the county of Lancaster, for his invention of certain improvements in machinery or apparatus for hewing, dressing, splitting, breaking, stamping, crushing and pressing stone, or other materials.*—[Sealed 2d December, 1844.]

This invention consists, in the first place, in causing high pressure steam to exert its elastic force, in a direct manner, for alternately lifting up, and accelerating the fall of a piston, sliding in a vertical cylinder; to which piston certain chisels, cutters, stampers or hammers, are attached, for the purpose of hewing, dressing, splitting, breaking, stamping, crushing and pressing stone, or other materials. And, secondly,—this invention consists in the peculiar manner by which the speed or number, as well as intensity of the blows, are modified, as may be desirable in the various stages of the before-named processes.

The drawing represents the improved apparatus in sectional elevation. It consists of a cylinder A, in which is fitted a piston B, and piston-rod C, working through a steam-tight stuffing-box D. The steam is conveyed to this cylinder from a suitable boiler, through a pipe E, so that by means of a slide-valve F, (in all respects similar to that generally employed in high pressure steam engines,) the steam is permitted to exert its elastic force upon the upper and under sides of the piston B, alternately, by the sliding up and down of the valve F, which receives its motion from a small piston sliding in a cylinder G, the piston-rod of which is at the same time the valve rod for the

valve F; the requisite amount of motion of this valve F, being regulated by a small crank and fly-wheel *g*, *g*, which, at the same time, gives the duly regulated motion to the valve of the small cylinder G, by means of an eccentric at W.



The piston-rod C, is attached to a cylindrical block of iron K, sliding nearly air-tight within a cylinder H, placed immediately under the cylinder A. Steam being admitted by a pipe at I, to the small cylinder G, it immediately gives a rising and falling motion to the valve F, the rapidity of which motion is regulated by the rate of admission and pressure of the steam let into the small cylinder G. While the valve F is being thus moved, steam is permitted to enter by the pipe E, and so obtain access alternately to the upper and under side of the piston B, which, together with its block K, is lifted up and forced down with a degree of force and rapidity due to the pressure of the steam on the piston B, together with the weight of the mass K. But as there would be nothing to limit the motion of the piston B, in its upward and downward action, except its coming in contact with the top and bottom of the cylinder A, which, in its action, would soon knock out and destroy that part of the apparatus, it becomes requisite to give a certain and definite motion to the piston B, and its block K. To attain this object the following means are adopted: In the cylinder H, above and below the upper and under sides of the block K, are spaces nearly equal to the spaces above and below the upper and under sides of

the piston B; the object of which is, that when the upper edge of the block K, in its upward motion, passes the hole L, the air remaining in the space M, M, is shut up and confined, and as it cannot escape so fast as it is compressed by the violent upward motion of the block K, it very soon acquires a degree of elasticity sufficient, not only to prevent all risk of the upper end of the block K, from striking the bottom of the cylinder A, and also that of the piston B, striking the top of the cylinder—but, what is of more importance, the so confined and compressed air exerts a powerful elastic action, which gives vast energy to the downward action or blow, which is given out by the fall of the block K, aided by the pressure of the steam on the top of the piston B, together with that of the compressed air on the upper side of the block K.

The patentee having thus described the manner in which the upward action of the block K is limited, he proceeds to state how the downward action of the block K, is also limited. It will be seen that the cylinder H, has a bottom at N, furnished with a nearly air-tight hole *n*, through which the chisel or cutter-holder T, slides; and, as the under edge of the block K, in its downward action, confines and compresses the air in the space P, P, by passing the hole O, it shuts up the air in the space P, P, in the same manner as in the upward action; so that, according to the degree of intensity with which the block K, is required to transmit its momentum to any object placed under the chisel-holder T, all that has to be done is to regulate the degree of compression of the air in the under chamber P, P, which is accomplished in the most simple manner, by having means to regulate the size of the escape aperture at Z. By this simple means, a species of elastic or springing blow is obtained, which allows of a delicate touch or powerful blow being given to any object placed under the chisel-holder T; besides which, the elasticity of the air-cushion in the chamber P, P, very importantly assists in recommencing the upward motion of the block K, without any jerk or destructive action whatsoever. The same means are also provided for regulating the elastic air-cushion in the upper chamber M, M. On the return stroke of the block K, the holes L and O, permit the air to re-enter, with perfect freedom, at every stroke.

It will now be evident, that by means of this apparatus, all due power and control being obtained over the energy of motion of the block K, its action may be applied to give the requisite lifting and falling action to certain chisels, cutters, stampers or hammers, such as may be attached or fixed to the end of the holder T, so that on placing an object, as a block of stone, or other material, under the chisels, and at a due distance, the surface of the stone will receive such a portion of the full force of the blow, arising from the fall of the block, as it may be desired to receive. In the case of hewing or chopping the surface of stones by such means, all that has to be done is to fix the stones on to a sliding-table, which has a progressive motion given to it in directions at right angles to each other; so that, by the combined or separate action of such sliding motion, all or any portion of its surface may be brought in succession under the action

of the blows transmitted to it by the rapid rise and fall of the block K, and its attached chisels; and by the due regulation of the air-cushion under the block K, in the chamber P, P, powerful blows or delicate touches may be transmitted to its surface at pleasure, in any order or degree of variety, both as to force and rapidity; the air-cushion regulating the force, while the admission of the steam into the cylinders G and A, regulates the rapidity.

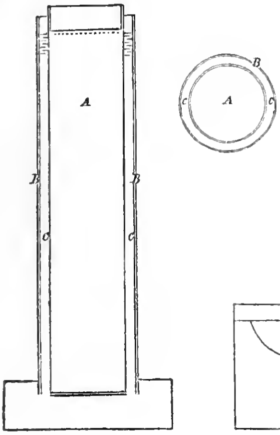
The patentee claims, Firstly,—the direct application of the elastic force of steam to raise and depress the tool or tools by which stones may be chipped or dressed, whatever may be the character or construction of steam-engine by which such elastic force is brought to act directly in raising and depressing the working chisel, pick, or other tool, that operates upon the surface of the stone. Secondly,—the employment of compressed air, or air-cushions, to temper or regulate the action of the steam-piston, and the intensity of the blow given by the tool in the act of striking the surface of the stone; also, the means described by which the elastic resistance of such volumes of compressed air are varied, in order to modify and determine the force of the striking-tool, according to the work under operation.—[*Inrolled June*, 1845.]

Specification of the Patent granted to Charles Sanderson, *of Sheffield, in the County of York, for certain improvements in combining Steel and Iron into Bars, for Tyres for Wheels, and for other purposes.*—Sealed November 4, 1845.

To all to whom these presents shall come, &c., &c. In producing articles which require a large portion of their surface to be covered with cast steel of any description, two principal difficulties present themselves. Firstly, that of obtaining a perfect weld or union of the two metals; and, Secondly, as such union is obtained through the medium of heat, to obtain it without injury to the cast-steel. My mode of attaining this effectually and economically, I will now explain, which is as follows. I take iron which has been manufactured by the usual process into a bloom, of any form required; this is heated and passed between suitable grooved rollers, or placed under a hammer to form a cavity, of such depth and width as shall be sufficient to contain the quantity of steel required to be incorporated with the bloom of iron; this cavity being made, a small strip of iron is welded upon the face or open side, thus forming, from end to end, a tube or opening into which the fluid steel is to be poured, as is shown at figure 1, which represents the section of a bar according to my invention. A, represents the bloom of iron, produced by any of the ordinary processes of iron making. B, is the indenture or cavity made into such bloom whilst hot, by a hammer tool, passing it through suitable grooved rollers, or by any other convenient means. C, represents the small strip of iron, which is welded to the two outer edges, D, D, of the bloom of iron, thus leaving, throughout the whole length of the bloom,

the cavity, B, which is intended to be filled with steel in a fluid state.

2



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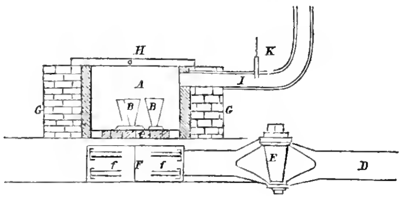

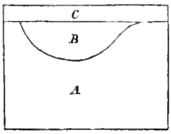

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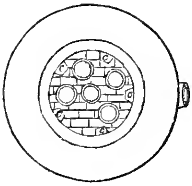

4

Should it be required to cover two, three, or even four sides of the iron, this is effected by making cavities of such sizes and forms as may be required, so that when the bloom is further manufactured into that form for which it may be required, the steel may be found united to the iron exactly where it is required.

In covering pieces of iron, of a circular form, such as for the manufacture of rollers, piston rods, mandrils, &c., when the bloom of iron is obtained, to the form and size required, I make an outer tube of thin iron, of such dimensions, that the inside diameter shall be the size of the iron bloom, together with the thickness of steel required to be welded to its surface, the thin coating of iron being subsequently turned off in the lathe or ground away.

The section, A, figure 2, is the bar of the form required to be covered all over with steel; B, is an iron case, about the one-sixteenth of an inch thick, and C, shows the cavity which is intended to be filled with fluid steel; thus, if it is desired to coat the surface with steel one inch thick, it is evident that the outer rim must be made two inches larger in diameter than the piece of iron requiring to be coated. The iron being thus prepared for the reception of the steel, the bottom end being open, is stopped in any convenient manner, to prevent the fluid steel from escaping, when poured into the cavity.

The furnace usually employed for melting steel may be used, but for the purpose of obtaining the steel in a fluid state, as economically as possible, I prefer to use an arrangement, shown at figure 3, in which A, is the body of the furnace, containing two or more crucibles B, B, which rest on the bottom of the furnace C, which may be built of solid fire-brick, having holes pierced at convenient distances, marked C, figure 4, to allow the air, which is introduced from a blast machine through the pipe, D, and regulated by a cock or valve, E. The air chamber, F, may be formed of cast-iron plates, as well as the outer part of the furnace itself, G, G, having a small door, *f*, *f*, for the pur-

pose of cleaning the furnace when required. The fuel is introduced by removing the cover, H, and the redundant heat, smoke and gases, evolved, are allowed to escape through the chimney, I, regulated by a damper, K. In this furnace, I am enabled to obtain not only a greater but a more equal degree of heat by regulating the valves, E, and K, using at the same time, a fuel much inferior, and consequently less costly than that now employed.

The iron being made ready for the reception of the steel, and the lower end being closed, I draw the crucibles from the furnace above described, and pour the fluid steel into those cavities made to receive it, the crucible is then returned to its furnace to be recharged with steel. The blocks of iron and steel, not being united or welded together, I place them in a reverberatory furnace, such as is commonly used for the manufacturing of iron, and heat them gradually to a welding heat; each block is then withdrawn from the furnace, and submitted to the blows of a heavy hammer, for the purpose of effecting a perfect weld or union of the two metals. To effect this union, however, I prefer to pass each block as it comes from the furnace, at a welding heat, through rollers, or under a powerful press or squeezers, as usually employed in iron works, which, whilst it firmly unites the iron and steel, may be made to give the blocks that form which is most convenient for its succeeding manufacture, whether it be intended to hammer or roll the same into a tyre bar, or any other form.

Having thus described the nature of my said invention, and the manner of performing the same, I would have it understood that what I claim is,

Firstly, the mode of manufacturing blooms of iron, with cavities of any form or size desired, which are to be filled with steel in a fluid state, in the manufacture of articles requiring steel to be welded upon the surface.

Secondly, I claim the use of an outer coating of iron, when using melted cast-steel, in order to protect the steel from injury by fire, during the subsequent operation of welding the iron and steel together.

Thirdly, I claim the mode of pressing the iron and steel blooms, when at a welding heat, instead of hammering them, and during such pressure to give them such form as may be best adapted for their future manufacture.

Fourthly, I claim the use of the blast furnace, in contradistinction to the present air furnace, for melting the steel as herein specified.

Enrolled May 4, 1846.

MECHANICS, PHYSICS, AND CHEMISTRY.

Terms used in Mechanics.

I.—Efficiency—Laboring-force—Power—Duty.

Scarcely had mechanics been brought under the cognizance of mathematical investigation when a dispute arose respecting the mea-

sure of the force of a body in motion—a dispute which for half a century was conducted with more vehemence and acrimony than might be supposed incident to the nature of an abstract subject, and which "was rather dropt than ended, to the no small discredit of mathematics, which has always boasted of a degree of evidence inconsistent with debate that can be brought to no issue."* On one side it was contended that the true measure is found by multiplication of the weight of the body into its velocity ($W \times v$): while on the other it was contended with equal confidence that the proper measure is the product arising from the weight multiplied into the velocity squared ($W \times v^2$.) The former definition ($W \times v$) mainly supported by comparison of inertiæ, and the relations of bodies to a common centre of gravity in planetary systems, was most commonly received as the more simple and consistent. Still the question remained undecided, and adverting to the collision of elastic bodies, and that property of motion known as the principle of *vis viva* there seemed to be equal argument in favor of the definition ($W \times v^2$).

At length it was fortunately observed that the different properties indicated by these two functions were not in reality at variance with each other, and the terms *momentum* and *impetus* with their synonyma, reconciled all opinions, and removed the basis of the dispute. It was further observed that neither impetus nor momentum has much to do with practical mechanics, since neither of these functions measure directly the efficiency developed in ordinary machines. The criterion of their efficiency is the force multiplied by the space through which it acts ($F \times s$); and the effect thus developed, measured in the same way, has been appropriately termed *duty*—a term first introduced by Watt in ascertaining the comparative value of his engines when he had assumed as a dynamical unit a pound weight raised one foot high.† This definition is founded on the manifest assumption that the resistance remaining the same in every new point of space, the pressure must likewise be exerted afresh at every point through which the resistance is overcome. This does not directly apply to the case of a body projected by an impulsive force, for then the body ascends, supposing the impulse to be upwards, through a certain space, proportioned to the force accumulated in the body, in conformity with the laws of motion; but if a body be raised slowly by a rope, we cannot for an instant relax our exertion, for if we do, the body immediately begins to descend, unless prevented by some special contrivance, in obedience to the law of gravity; and during the ascent we find that a new pressure is necessary to draw the body through every particle of space. Similarly, if a certain amount of exertion be requisite to saw through an inch of a uniform block, it will require an equal exertion to saw through the next inch of the

* Reid's Essay on Quantity.

† The dynamical unit termed a *horse-power* is 33,000 lbs., or 528 cubic feet of water, raised one foot high in a minute. The *Cheval Vapeur* of the French Engineers is 75 kilogrammes raised 1 metre per second; and as the metre is 3·28 feet and the kilogramme 2·2 lbs., the *Cheval Vapeur* will be equivalent to 31500 lbs., raised 1 foot per minute. It therefore follows that 100 English horse-power is equivalent to 105 French nearly.

same block; and after each exertion of force the object will remain where it is and as it is, unless a new exertion of force carry on the work. Hence we conclude that the laboring force exerted is proportional to the resistance and the space conjointly, and may be measured and expressed by the product of two numbers representing these quantities, that is by $(F \times s)$.

Now, as every resistance may be expressed by weight, and the overcoming of resistance may be represented by raising a weight equivalent to the resistance so measured through a vertical space, it being always supposed that the weight will remain at the point to which it is thus raised, this affords a convenient mode of estimating and of representing the mechanical efficiency of a given mechanical agency. Thus, if it requires a force of 100 lbs. to draw a carriage along a road, the power expended in drawing the carriage through 50 feet may manifestly be measured by the laboring force which would raise a weight of 100 lbs. through a height of 50 feet. Hence the laboring force is independent of the nature of the work done—which is infinitely diversified by the mechanism employed; and it is also always equal to the sum of the effects produced. Much of it may be uselessly expended in the mechanism, and therefore lost for useful purposes, and hence the value of one species of machine as compared with another—that machine being the best which transmits the highest per centage of the power applied to it. Thus, if a man's weight be 100, and he be capable of raising a weight of 90 by a single pulley and rope, the duty is to the laboring force or power as 90 to 100, or 10 per cent. of the power has been expended in overcoming the friction of the pulley and the rigidity of the rope. By diminishing the amount of these resistances the duty may be correspondingly increased; or the same weight may be raised by a less expenditure of power. What is obviously true in this case is equally true of any mechanism however complicated. Thus, if F be the pressure exerted upon the first piece of mechanism in the direction of its motion, and S the space through which it moves in any given unit of time; and if f be the pressure exerted by the last piece of mechanism upon the work, and s the space through which it moves in the same unit of time; further, if p express the amount of power necessary to overcome the friction in the mechanism itself, then, whatever be the nature or extent of the train, we have

$$f \times s + p = F \times S.$$

By the same reasoning, the amount of laboring force corresponding to a given space is not altered by altering the velocity of working, provided the pressure F and f remain constant. But in many cases the pressure exerted changes with the change of velocity, and accordingly the power will vary with the varying rate of working; and there may be a rate of working for which the power is a *maximum*. Thus, a water-wheel would yield no mechanical efficiency at a velocity equal to that of the water which impels it; and taking the common formula to express the horse power of a locomotive engine, viz., $(L \times S) - 62 \cdot 5$ (in which L is the load in tons, and S the speed in miles per hour,) it is obvious, taking the limits of L and S at the load

which the engine is just capable of moving, and the speed which it would attain without any load, that the maximum of effect must lie somewhere between.

"In connexion with this subject it may be observed generally, that the conditions under which machines produce this maximum effect, may be considered either in respect of the mechanical effect which they are capable of deriving from a given exertion of the motive power, or in respect of the amount of mechanical effect which they are capable of exerting with reference to the expenditure of the impelling force. These conditions are moreover very rarely separable, so that to obtain a maximum effect in one sense, very commonly involves different conditions to those which would produce it in the other. To obtain the maximum effect from a given expenditure of motive force, the machine must be adapted to receive the greatest amount possible of the motive force, and not permit any portion of it to be expended without producing its full effect in impelling the machine. This most obviously depends upon the mechanical organs of the machine being perfectly proportioned to the forces which are to act upon them, according to the velocity, intensity, and direction of those actions, and must have reference to some particular velocity with which the motive force is required to impel the machine; but it is also equally obvious, that each kind of motive force having some particular velocity at which it can act with the greatest advantage, if we exact from the machine a higher velocity of motion than is consistent with the activity of the impelling power, we can only obtain it by a sacrifice of mechanical effect. Thus the useful effect due to animal exertion decreases rapidly as the speed increases. A horse, for instance, cannot move its limbs quicker than a certain velocity, even if it had no resistance to overcome; and it is only when working at the most advantageous speed that its mechanical effect can be valued at 33,000 lbs. raised 1 foot per minute.* On the other hand, a resistance may be opposed so great that the animal cannot move at all; and in this case, as well as in that of excessive velocity, no mechanical effect is realized. In the same manner the natural currents of wind and water are limited in the rapidity of their motions, and will act as motive forces most efficaciously when the recipients are adapted to their respective velocities; that is, when the parts of the machine to which the motion is applied act only at such velocities as to receive the whole force of the current. If the motion of the recipient be greater—should it approximate to that of the current—then a part only of the force will be realized; for the current, when it has passed from the machine, will retain the same velocity as the parts upon which it acted, and consequently a motive force corresponding to that velocity, which has produced no useful effect upon the machine. In like manner, the elastic force of steam is limited in the velocity of the motion with which it can act upon the piston (in the steam engine); and in the case of the locomotive engine, the velocity

* The average value of a horse is from 21000 to 22000 lbs. raised 1 foot per minute. What is known as a horse power in mechanics is really equivalent to one and a half times the power of the animal.

corresponding to the maximum effect may be passed. It is however to be remarked that this limit is brought greatly nearer by the practical necessity there is of contracting the apertures by which the steam is admitted into the cylinder; the motive force is thereby not permitted to act freely upon the piston, but only with a limited activity; and further, that certain of the resistances—the resistance, for instance, arising from the action of the atmosphere upon the train, and of the blast pipe against the piston—increase with the velocity, so that at a certain speed, easily determined by calculation (where the data are determined,) the augmented resistance becomes equal to the diminished motive force. This is the limit of velocity, for there being no preponderance of motive power, there cannot be any acceleration; and a dynamical equilibrium being established, the motion will continue uniform. Did these conditions not exist—had the steam no contracted orifices to pass through, and were there no augmentation of resistances with increased speed—then the velocity of a locomotive, and the power of steam engines generally, would be limited only by the rate of vaporization in the boiler."*

In any moving body there is accumulated by the action of the forces whence its motion has resulted, a certain amount of power which it reproduces upon any resistances opposed to its motion, and which is measured by the effect produced upon that obstacle. It is this accumulated power which has been called *impetus* by Dr. Wollaston, and *energy* by Dr. Young, and on which the dispute respecting the measure of dynamical force was so long maintained. Thus, in a ball fired from a cannon there is an accumulated power ready to be expended upon any obstacle it may encounter in its flight; and in the water which flows through the channel of a mill-lead there is accumulated the power which is transferred (in part) to the undershot wheel. Similarly, a carriage descending an incline, if allowed to descend freely, accumulates a power sufficient to carry it a considerable distance up the next incline. In those and analogous cases, the pressure for a time exceeds the resistance, and that surplus pressure is accumulated in the moving body, and it is easily shown that in every case, the power accumulated is precisely equal to the power expended upon the body beyond that necessary to overcome the resistance opposed to its motion; a principle, indeed, which might almost be assumed as in itself evident. It is likewise evident that the power accumulated in a moving body will be the same for the same velocity, under whatever circumstances that velocity has been acquired. Whether the velocity of a ball has been communicated by projection from a steam gun, or by explosion from a cannon, or by being allowed to fall freely from a sufficient height, it matters not to the result, provided the same velocity, v, be communicated to it in all three cases, and it be of the same weight, w, the power accumulated in it, estimated by the effect it is capable of producing, is evidently the same.

To estimate the power so accumulated in a body moving with a

* The Engineer and Machinist's Assistant, at present being published in monthly Parts. Blackie & Son, Glasgow.

given velocity, let us suppose that the body is projected with the velocity v in a direction opposite to gravity: by the laws of motion, it will ascend to the height h, from which it must have fallen to acquire the same velocity v; there must then at the instant of projection have been accumulated in it a force sufficient to raise it to the height h; but the number of units of power requisite to raise a weight w, to a height h, is represented by the product $w \times h$, for here h represents the space s, through which the force is exerted, and therefore $w \times h$ agrees with the definition $F \times s$. Now, cause and effect being equal, $w \times h$ will likewise express the number of dynamical units accumulated in the body at the instant of projection. But since h is the height from which the body must fall to acquire the velocity v, and since* $v = \sqrt{2gh}$ by the laws of falling bodies: therefore $h = \frac{1}{2}\frac{v^2}{g}$; hence replacing h by its equivalent in the expression $w \times h$ and taking U to represent the number of dynamical units accumulated, we have

$$U = \frac{1}{2}\frac{w}{g}v^2$$

It therefore appears that the power accumulated in a moving body, however its velocity may have been attained, whatever may have been the circumstances under which that velocity was acquired, is *proportioned* either to the *space* through which the moving force is exerted, or to the *square* of the velocity of the body in which such force is accumulated. "Thus a bullet moving with a double velocity will penetrate to four times the depth in a bed of clay of uniform consistence: a ball of equal size, but of one-fourth part of the weight, moving with a double velocity will penetrate to an equal depth. Thus also when the resistance opposed by any body to a force tending to break it, is to be overcome, the space through which it may be bent before it breaks being given, as well as the force exerted at every point of that space, the power of the body to break it, is proportional to its weight, multiplied into the square of its velocity." And from this it follows that to double the velocity we must apply four times the power. Thus, were it necessary to obtain a certain velocity by means of the descent of a heavy body from a height, to which we carried it by a flight of steps, we must ascend, if we wish to double the velocity a quadruple number of steps, and this will cost four-times as much labor. Glas. Prac. Mech. and Eng. Mag.

* The force of gravity is, in respect of the descent of bodies near the earth's surface, a constantly accelerating force, increasing the velocity of their descent by 32·2 feet in each successive second; in like manner if they be projected upwards, it becomes a constantly retarding force diminishing their velocity by that quantity each successive second of time. The symbol g is commonly used to denote the number 32·2 and is so used above.

On the Application of Voltaic Ignition to Lighting Mines. By W. R. Grove, Esq., *M. A., F. R. S., Professor of Experimental Philosophy in the London Institution.*

In the *Comptes Rendus* of the Paris Academy of Sciences for the 1st and 15th of September last, are communications by M. Boussingault and M. De la Rive, on the employment of the voltaic disruptive discharge for the illumination of mines. M. Boussingault is inclined to believe that some of the accidents in mines have occurred from draughts or currents of inflammable gas, and not from the carelessness of the workmen in the use of the safety-lamp, to which they are generally attributed; he considers that the voltaic arc, being independent of atmospheric air or other supporter of combustion, in the usual sense of the word, might be rendered practically available. M. De la Rive states that he has been occupied with the subject, and proposes a cylinder of close-textured charcoal, similar to that of Bunsen, with a metallic ring or plate above it; the carbon being rendered the positive terminal of a voltaic pile, the particles transferred from it to the disk fall down again by their own gravity, and a tolerably constant light is obtained; the vessel containing the electrodes is hermetically sealed, and the oxygen being soon exhausted by the ignited charcoal, the ignition proceeds in the residual nitrogen. M. De la Rive appears, however, to have met with but partial success, and says there are still many difficulties to contend with.

Four or five years ago, soon after publishing the nitric acid battery, I was naturally struck by the facility and constancy with which the voltaic arc could be obtained by that combination, as compared with any previous one, and made several attempts to reduce it to a practical form for the purposes of illumination, but my success was very limited. By attending to certain precautions, which I will not stop to describe, I could occasionally keep up a steady voltaic light in attenuated nitrogen for four or five hours, but it was never sure; from some unseen imperfection in the charcoal, or other cause, it would become suddenly extinct; the glass also in which it was ignited became gradually dimmed by a deposition of condensed carbon vapor; it was costly, from the number of series, and consequently of equivalents of zinc and acid consumed; too bulky for portable purposes, and from the intensity of the heat, unless the recipient was very large, the collar of leathers and joints, into which the wires were sealed or cemented, were destroyed; and when ground plates were employed, the grease was liquefied. M. de la Rive does not state his method of hermetically sealing the vessel he employs; this I found one of the most difficult parts of the process. Not being able satisfactorily to overcome these difficulties, I abandoned it for the time, and made some experiments on another method of voltaic illumination, which appeared to me more applicable to lighting mines; their publication was postponed, and I had nearly forgotten them, until reminded by the papers above mentioned.

I substituted the voltaic ignition of a platina wire for the disruptive

discharge. Any one who has seen the common lecture-table experiment of igniting a platina wire by the voltaic current nearly to the point of fusion, will have no doubt of the brilliancy of the light emitted; although inferior to that of the voltaic arc, yet it is too intense for the naked eye to support, and amply sufficient for the miner to work by. My plan was then to ignite a coil of platinum wire as near to the point of fusion as was practicable, in a closed vessel of atmospheric air, or other gas, and the following was one of the apparatus which I used for this purpose, and by the light of which I have experimented and read for hours:—A coil of platinum wire is attached to two copper wires, the lower parts of which, or those most distant from the platinum, are well varnished; these are fixed erect in a glass of distilled water, and another cylindrical glass closed at the upper end is inverted over them, so that its open mouth rests on the bottom of the former glass; the projecting ends of the copper wires are connected with a voltaic battery (two or three pairs of the nitric acid combination,) and the ignited wire now gives a steady light, which continues without any alteration or inconvenience as long as the battery continues constant, the length of time being of course dependent upon the quantity of the electrolyte in the battery cells. Instead of making the wires pass through water, they may be fixed to metallic caps well luted to the necks of a glass globe.

The spirals of the helix should be as nearly approximated as possible, as each aids by its heat that of its neighbor, or rather diminishes the cooling effect of the gaseous atmosphere; the wire should not be too fine, as it would not then become fully ignited; nor too large, as it would not offer sufficient resistance, and would consume too rapidly the battery constituents; for the same reason, *i. e.* increased resistance, it should be as long as the battery is capable of igniting to a full incandescence.

The helix form offers the advantages, that the cooling effect being lessened, a much longer wire can be ignited by the same battery; by this increased length of wire, the battery fuel is economised, while a greater light is afforded; by the increased heat, the resistance is still further increased, and the consumption still further diminished, so that, contrary to the usual result, the increment of consumption decreases with the exaltation of effect produced. The very necessity of inclosing the coil in a glass recipient also augments the heat, the light, and the resistance; if I remember rightly, Mr. Faraday first proposed inclosing wire in a tube for the purpose of being able to ignite a longer portion of it. Lastly, only two or three cells are required, (one indeed might be sometimes sufficient,) and the whole apparatus thus becomes portable and economical. The light is perfectly constant, subject to no fluctuation or interruption, and the heat is not so excessive as to destroy the apparatus.

As the effect of different gases on radiant heat is an important element in the practical application of the above, I had commenced some experiments on this subject, and the following I find in my note-book as the effect of four different gases. A voltameter was interposed in the circuit in order to furnish a better test of the amount of ignition

than the eye, as, according to the position of Davy, that a wire becomes a worse conductor in proportion to its increase of temperature, the amount of gas in the voltameter should be, as indeed in these experiments it turned out to be, in inverse proportion to the degree of ignition. As a further test, the increased volume of the gas by expansion was noted, though the apparatus was not constructed for showing this increase with delicate accuracy.

Platina wire ignited by a given constant voltaic battery in	Effects to the eye.	Voltameter gave at the rate of one cub. in. in	Expansion of volume.
		"	
Hydrogen . . .	Not visible even in the dark .	19	35 to 43
Carbonic acid .	Cherry-red by daylight . .	21·5	35 . . . 43
Oxygen	Incandescent by daylight . . .	23·5	35 . . . 45
Nitrogen	Same	24	35 . . . 45
Atmospheric air	Same	24	35 . . . 45

I had intended to have carried these experiments further with other gases,* and also with condensed and rarefied air, but was interrupted; and as it may be some time before I may be able to renew them, I think I cannot do better than submit these experiments, with your permission, to the readers of the Philosophical Magazine, while the attention of scientific men is directed to this subject; actual practice can alone test their efficacy. Lond., Edin. & Dublin Philos. Mag.

Telegraphic Communication between France and England.

Amidst the many wonderful inventions of modern days, wherein the faculties of man have overcome difficulties apparently insurmountable, and made the very elements themselves subservient to his power and use, there are none more wonderful than that now about to be carried out by the establishment of submarine telegraphs, by which an instantaneous communication will be effected between the coasts of England and France. The British Government, by the Lords Commissioners of the Admiralty, and the French Government, by the Minister of the Interior, have granted permission to two gentlemen, the projectors of the submarine telegraph, to lay it down from coast to coast. The site selected is from Cape Grisnez, or from Cape Blancnez,

* I have some doubt whether the different gases do not exercise a specific action on the ignited wire, somewhat in the nature of catalysis; if a wire be brought by the voltaic current to a white heat in atmospheric air, and a vessel of hydrogen inverted over it, the light is as suddenly extinguished as the flame of a candle would be.

on the French side, to the South Foreland, on the English coast. The soundings between these headlands are gradual, varying from seven fathoms near the shore on either side to a maximum of 37 fathoms in mid-channel. The Lords of the Admiralty have also granted permission to the same gentlemen to lay down a submarine telegraph between Dublin and Holyhead, which is to be carried on from the latter place to Liverpool and London. The submarine telegraph across the English Channel will, however, be the one first laid down: the materials for this are already undergoing the process of insulation, and are in that state of forwardness which will enable the projectors to have them completed, and placed in position, so that a telegraphic communication can be transmitted across the Channel about the first week in June. When this is completed an electric telegraph will be established from the coast to Paris, and thence to Marseilles. This telegraph, throughout France, will be immediately under the direction of the French Government, as, according to the law of 1837, all telegraphic communications through that country are under the absolute control and superintendence of the Minister of the Interior. Upon the completion of the submarine telegraph across the English Channel, it is stated that a similar one, on the most gigantic scale, will be attempted to be formed under the immediate sanction and patronage of the French Administration; this is no less than that of connecting the shores of Africa with those of Europe by the same instrumentality, thus opening a direct and lightning-like communication between Marseilles and Algeria.

Railway Magazine.

Mr. Rand's inventions for the Manufacture of Flexible Metal Tubes for preserving Paint and other matters.

Mr. Carpmael stated that Mr. Rand, who is an artist, had, from the inconvenience and waste of color which takes place when it is put in the bladders ordinarily used, been led to endeavor to find a substitute, and the use of metallic vessels suggested itself. After experiments he succeeded in forming them of so thin a body of metal that they are capable of being collapsed so as to shut out all air. The tubes are made of block tin the 150th part of an inch in thickness, and have at their upper end a nozzle and screw cap, and are closed at the bottom by being folded over once or twice with a pair of pincers so as to exclude all air. As the color or other matter which they contain is pressed out, the tubes are collapsed and thus the upper part of the tube always remains full. Each tube has to go through the following process of manufacture :—A small piece of block tin is put into a die upon which a punch worked by a fly-press descends and forces the metal up, of the required thickness, between the surfaces of the die and the punch; thus by a single blow the body of the tube is formed. It is then removed to a second press, by which the screw on the neck of the tube is formed, and by a second blow, in the same press, the maker's name is stamped upon it. The cap is

formed in a similar manner by a third machine. The tube when struck is placed on a lathe and cut the required length. Thus an air-tight bottle is formed without seam in a few seconds.

Trans. Roy. Scot. Soc. of Arts, April 15.—Civ. Eng. and Arch. Journ.

On the Manufacture of Steel. By Dr. Carl Schafhaeutl.

(Translated from the Revue Scientifique et Ind. du Dr. Quesneville.)

Iron, in the composition of which a portion of the silica is replaced by manganese, will, while being smelted, rather part with the latter than the former. From this it follows, that at the moment when the iron is on the point of passing from a liquid to a solid state it will retain sufficient silica to form steel. For this reason, during the whole process of refining, the current of air is caused to act rather upon the surface of the metal than through the interior of the fluid mass, in order to avoid the combustion of too much carbon and silica; from which it follows that the casting becomes malleable without losing a sufficient quantity of silica to constitute iron, properly so called, and the product is raw or blistered steel. The casting which does not contain any manganese, loses, by the effect of combustion, a portion of silica proportionable to the quantity of carbon burnt, and furnishes iron only, as a definitive product.

It is simply to the mechanical action of the hammer that the distinctive features of steel, as compared with cast metal, are due. In order to effect this change, the blistered steel is broken into pieces and melted down; they are afterwards tempered—again broken into pieces, and welded together at a good welding heat. The steel will be the more malleable, and possess more tenacity and uniformity of texture, in proportion to the number of times these operations are repeated. The product is called "wrought or shear steel."

Steel of cementation and cast-steel.—When bar-iron is heated to a white heat, or even melted in close vessels containing coal or carbonaceous substances, it takes up a certain quantity of carbon, and is transformed into castings of various kinds.

If the iron contains, together with silica, phosphorus and arsenic in proportions suitable for softening the granular particles of iron during their combination with the carbon, by keeping it for a certain time at a red heat, with powdered charcoal, a casting is obtained, which, when submitted to the action of the hammer, or of rollers, furnishes a product known as "steel of cementation." During this operation, the stratum of oxide which covers the particles of iron inside loses its oxygen, and passes again into a metallic state; but the vacant spaces occasioned by this are filled up, as the ferruginous particles, which are in a semi-fluid state, re-assume the crystaline form. The carbonic oxide gas, in escaping, forms large blisters on the surface of the metal, under which the softened mass crystalizes. On being broken, the interior of these blisters, instead of appearing of a dark color, in-

dicating the presence of a stratum of protoxide, presents a brilliant and rainbow-tinted appearance, the yellowish and bluish tints distinguishing bronzed steel being observable. If this steel be wrought at a white heat, these blisters will weld in with the mass with the greatest facility. During cementation, the carbon combines with the component particles of the iron in various proportions, depending in a great degree upon the chemical composition of those particles. It is, therefore, a vulgar error to suppose that steel of cementation contains more carbon at the surface than in the interior, as stated in all technological treatises. Thus, in the best Dannemora steel, it very frequently happens, when the cementation is finished, that the centre of the metal contains a much greater quantity of carbon than the superficial portions. It may also happen that steel produced from the best Dannemora bar-iron will differ in an extraordinary manner as regards hardness, in various portions of the bar; and for this reason, in steel works in England, the bars of steel are always broken into several pieces, in order to class those pieces together which are the most similar in quality.

If ordinary iron be submitted to cementation, that is to say, iron in which the proportion of silica is ordinarily insignificant, when compared with that of carbon, and that independently of this the iron is deficient in the quantity of phosphorus and arsenic necessary for easily softening the metallic molecules, only carburet of iron and a little siliciuret of iron are produced, but the carbon does not combine with the silica. In this case the steel obtained is deficient in malleability and tenacity,—for this reason, that the molecules will not unite or crystalize until they have taken up a quantity of carbon more than sufficient to produce steel. With regard to simple carburetted iron (when it contains more carbon) it either will not harden at all when tempered, or becomes friable and brittle when heated to redness, even when it does not contain more carbon than steel of good quality.

The fracture of the steel of cementation, now under notice, is grey and dull, while steel of good quality is of a silvery aspect, and presents cubical crystals.

The best steel can only be obtained by the cementation of forged iron. Whilst the metal is combining with the carbon, the iron must not enter into a complete state of fusion, as in that case groups of crystals, each possessing a different degree of carbonization, would be formed; even the best Dannemora iron will not furnish a uniform product fit for purposes of commerce when melted with substances containing carbon. I am well aware that the experiments of Clouet, Hachette, and Bréant, may be opposed to me, as set forth in various treatises upon chemistry, but these are unfortunately mere laboratory experiments, the authors of which have prudently concealed, or passed over in silence, all those which were unsuccessful. When the operator has obtained a regulus at the bottom of his crucible, and when, after immense trouble, he has succeeded in extracting from it a small portion of steel capable of being worked, he immediately hastens to publish his pretended discovery in some journal, of which others become faithful and credulous echoes; thus, since the manu-

facture of steel has become the subject of chemical inquiry, complaints are daily becoming more frequent upon the difficulty of procuring steel capable of resisting the treatment to which it is subjected in the arts. If the persons who preside over the coining department either at London or Munich, were consulted, they would all agree in saying that it is now very difficult to meet with the quality of steel necessary for making the dies. Even in England good steel becomes more and more scarce. With regard to the manufactories of cemented or cast-steel established upon the continent, they furnish products, the quality of which is so uncertain, that the workman is often reduced, after having lost his time and trouble, to throw certain portions away, as they want the necessary uniformity and tenacity.

All the artificial alloys of steel with silver, of which so much has been said, are not fit for any thing, and are never met with in commerce.

When the steel has been withdrawn from the cementing furnace, and after it has been broken, and the pieces drawn out, they are submitted to one of the two following operations:—the pieces after being sorted are piled one upon the other and welded together, (this is called faggoting the steel,) or the sorted pieces are placed in clay crucibles of a nearly cylindrical form, and cast in a reverberatory furnace, in which two crucibles are placed, one behind the other, upon cakes of fire-clay; the orifice of these crucibles is closed by a flat cake of fire-clay. The bars of cemented steel, as above mentioned, are divided into pieces of one or two inches in length; these pieces are distributed, according to their degree of carbonization, in vessels fixed to the walls of the place in which the melting is carried on.

These different qualities of steel are generally combined in such a manner as to obtain a product the best suited for the purposes to which cast-steel is ordinarily applied.

In all treatises on practical chemistry it is asserted, that in order to melt steel, it is to be covered with a layer of glass or blast furnace slag; that the opening of the crucible is luted, or at least becomes firmly fixed during the operation; these assertions are, however, erroneous. In the first steel manufactories in Sheffield, steel only is put into the crucibles. With regard to the cover, it is evident that it must not adhere to the crucible, as it is necessary the operator should remove it from time to time with a bar of iron, in order to ascertain the state of the metal.

In order to obtain steel of the best quality, it is not sufficient that the melted mass be run into moulds: the most essential point is to make the casting at the proper time, and for this purpose the operator must be guided by the quality of the steel. This is the duty of the workman, who from long practice can tell the suitable point of fusion, either by simple inspection or by means of his bar of iron, with which he merely touches the surface of the metal, being most careful not to plunge it into the melted mass. As the quality and uniformity of the steel depend in a great measure upon the experience and judgment of the workman who directs the casting, it follows, that even in England, a good caster is much sought after and well paid.

It is not difficult, therefore, to explain why so many of the attempts made to establish manufactories of cast-steel in Germany have failed, and will again fail. Thanks to the errors propagated by technical works, and by the assertions of superficially informed travelers, who had frequently been purposely deceived, it was imagined that in order to obtain English steel of good quality, it was only necessary to melt cemented steel in a crucible, and afterwards pour it into moulds, when in a state of fusion.

As soon as a crucible is emptied, it is replaced in the oven; each crucible serves for one day's work, *i. e.*, four or five castings, after which it is thrown aside. For ordinary purposes, the steel is run into cast-iron moulds of a prismatic form, previously heated and closed. When the steel is required for making saw-blades, plates, &c., it is run into large moulds of a parallelopiped form. Steel which is very hard and highly carbonized, contracts considerably in the moulds; great skill is therefore required to run it into the moulds in such a manner that no vacuum may be produced. In that part of the prism corresponding to the jet, a funnel-shaped aperture, from one to two inches deep, is formed; this is detached and melted down with other pieces of steel.

The transverse fracture of a prism of hard steel is silvery, and has a number of rays radiating from the centre; steel less hard is on the contrary of a uniform granular and crystaline texture. This steel possesses all the brittleness of cast metal.

By fusion, steel of cementation acquires peculiar properties, and does not sweat so much as before casting.

When steel is produced from iron of bad quality, and carburets of a different nature are produced during cementation, the melting, instead of improving it, renders it much worse; as, in that case, the different carburets of iron, which are of inferior quality, separate still more during cooling. This has given rise to an old saying, well known among English founders, that "when the devil is put into the crucible, nothing but the devil will come out."

It is to the existence of these heterogeneous metallic carburets, which are produced during cementation in iron of inferior quality, and which form new combinations during the fusion of the metal, that the complaints of workmen working in steel are to be attributed. In fact, these carburets being only, so to speak, agglutinated, even in bars of forged steel, each of them, at the moment of tempering, is contracted or dilated more or less than the one immediately adjoining it, so that from that time a separation commences between the unequally carbonized layers; in other words, a flaw or crack is produced, which may be distinguished by a peculiar noise at the moment when the steel is plunged in the water, or, at least, there is a tendency to separation, which only requires the co-operation of an exterior cause, such as a shock, to effect it. This is often observed in razors, &c.

The transverse fracture of cast-steel ought to present a perfectly homogeneous surface, when the bar is broken by a sharp blow, after being cut or marked with a chisel. The slight inequalities which are perceptible ought to be undulating, and to blend insensibly at their

bases with the rest of the metallic surface. When, on the contrary, they stand out perpendicularly, the conclusion may be arrived at, that this portion of the bar was the point of contact of two unequally carbonized layers, which, by separating either at the moment of tempering, or at a later period, had inevitably given rise to this rupture.

Lond. Jour. Arts and Sciences.

Method of Extracting the Iodine and Bromine contained in the Salts and Mother Liquor of Kelp Soda.

(Translated from the Bulletin de la Société d' Encouragement.)

The Société d'Encouragement, in its general meeting of the 5th June, 1839, decreed a gold medal to *Messrs. Delaunay, Couturier, and Villedieu*, of Tourlaville, near Cherbourg, for their processes for extracting iodine and bromine from soda obtained from the sea-weed, which is gathered in large quantities on the shores of Brittany.

The importance of this manufacture was made known in a report inserted in the *Bulletin* of August, 1839; but it did not contain a description of the process. We will, therefore, make up for this omission, by giving an extract from the patent for ten years, taken by Messrs. Couturier, on the 22d May, 1835, and which has now become public property.

1st. *Extraction of Iodine from Kelp Soda.*—The mother waters of this soda having been concentrated to the greatest possible degree, are left in any suitable vessel, in order to allow the salts, which may be separated during its slow crystalization, to deposit; they are afterwards drawn off, and the small quantity of alkaline carbonate, which is always contained in these mother liquors, is saturated by means of sulphuric acid. In order to be certain that the free alkali of the mother liquors is saturated, the point of saturation must be slightly exceeded, which is ascertained when, after having sufficiently agitated the mother liquor to which the sulphuric acid has been added, a strip of litmus paper plunged into it is slightly reddened.

It often happens that the mother liquors of kelp contain a considerable quantity of hyposulphites which precipitate sulphur, and by the decomposition of which sulphurous acid is disengaged; in this case sulphuric acid is added, by small quantities at a time, until no more sulphur is precipitated. This clarified liquor is put into large vessels, which must not be quite filled, to allow the liquor to be stirred from time to time.

The bottles having been placed upon a table, a current of chlorine gas is directed to the bottom of the liquor they contain. This gas must not be disengaged too rapidly, otherwise a great part of it will be lost by traversing the liquor without being dissolved: attention to this is also necessary, in order to ascertain when to stop. It is important that the liquor should be agitated as often as possible, to enable it to combine with the chlorine gas which accumulates in the empty part of the bottles.

The chlorine gas, which is mixed with these mother liquors, acts

first upon the bases of the iodides, saturates them, and separates or precipitates the iodine; this latter appears at first in the form of a reddish substance, which thickens the liquor, but it soon forms into brown flakes, which fall to the bottom. When the liquor appears no longer to be colored red, a small quantity must be poured into a glass, and left for a time to allow the iodine floating therein to settle; after which some few drops of concentrated solution of chlorine are poured into the clarified liquor: the passage of the chlorine must be discontinued as soon as the solution ceases to thicken the mother liquor, which, on being left in a quiescent state, allows the iodine to settle at the bottom in the form of a thick layer of brilliant brown flakes.

If the iodine is required in large flakes, the supernatant liquor may be decanted off immediately, and washed in a small quantity of cold water; it is then to be put into a retort of glass or porcelain, and sublimed; a long tube of glass, of sufficiently large diameter, being adapted to the neck of the retort. The iodine is volatilized by the heat in the form of violet-colored vapors, which are first condensed in the neck of the retort, and afterwards in the tube, in the form of small plates or flakes, having a metallic lustre. When the vapors cease to be perceptible, the operation is completed: care must be taken to keep a cloth constantly wetted with cold water upon the whole surface of the tube. In working on a large scale, the products of several operations are united, left to drain, and sublimed as above described.

2d. *Extraction of the Bromine.*—The mother liquor having been completely exhausted of iodine, is introduced into a tubular retort until it is half full; powdered peroxide of manganese and concentrated sulphuric acid of commerce are to be added to it, and an apparatus composed of three recipients, which communicate by means of pipes ground with emery, is adapted to the neck of the retort: the distillation is then proceeded with, care being taken not to let it boil too fast. The bromine which is separated by this operation is volatilized and disengaged in the form of gold-colored vapors, which are partially condensed in the neck of the first receiver in the form of streaks and drops of a reddish-brown liquid, which run down by degrees into the receiver; but, as a considerable quantity of water is volatilized at the same time, it is condensed also, and floats upon the bromine, which occupies the lowest part of the liquor. When the colored vapors cease to be disengaged from the retort, the fire is removed; a fresh quantity of peroxide of manganese and sulphuric acid are then added, the retort is closed, and the fire again applied. If a sufficient quantity of these substances has been added at first, all the bromine will have been extracted; it then only remains to collect that which is below the liquor condensed in the receiver; this is done by means of a glass funnel furnished with a cock. When the separation is well effected, the end of the funnel is placed in a bottle, the cock is gently opened, and the bromine runs into the bottle; the cock is shut the instant all the bromine has run through and the water is about entering. This water holds a considerable quantity of bromine in solution, which is separated from it by collecting the residuum and

saturating it with a sufficient quantity of potash. The product of this saturation is afterwards evaporated to dryness, and the residue is calcined at a dull red heat with a small quantity of coal-dust; it is then dissolved in just a sufficient quantity of water; the solution is filtered and treated in the apparatus with peroxide of manganese and concentrated sulphuric acid, as above described.

The bromine thus obtained is rectified by means of distillation.

Lond. Journ. of Arts and Sci.

On the Theory of Photographic Action, illustrating the Connexion between the Photographic Agent and Electricity. By J. NOTT, ESQ.

Mr. Nott proceeded to say, that "since the discovery of Photography, there is, perhaps, no branch of electrical physics more interesting than that which comprehends the phenomena of phosphorescence. For though light be the apparent agent in the production of the photographic picture, yet the accompanying circumstances can only be satisfactorily explained by a reference to electrical principles. Light is a term merely relative to us; but light itself has no absolute existence any more than sound: then how unphilosophic are the terms, latent light, and light in darkness, which we sometimes hear—as if that which is merely an effect could be regarded as a cause, or as a physical force, at the same time that we know it is not possible to demonstrate the existence of any other physical force in nature than electricity. Light is, therefore, only an attendant circumstance in the production of the photographic picture; and this seems proved by the fact of one body impressing its image upon another in the dark, when the bodies are approximated at what, in electrical phraseology, is called the striking distance. As light then cannot be regarded as the photographic agent, electricity which, in all probability, is the principle of light, would seem to be; and the effects produced, when phosphorescence is developed through juxta-posed transparent media, of different densities or electrical affinities, bear so striking an analogy to those which are produced upon a sensitive surface when exposed to the action of light, reflected from bodies in different degrees of intensity, as to render it more than probable, that what is understood by the term photography, is a simple case of phosphorescence by insolation. For, as we find that some parts of the sensitive surface then exhibit what may be called an elective affinity for certain substances, while others do not, these effects can only be the result of simultaneous attractions and repulsions; the manifestation of which is inconceivable independently of the presence of electricity. The question then arises, if the photographic picture be the result of electrical action, why may not the color as well as the contour of bodies be taken down, seeing that color is not a property of matter, but is a property of light? All bodies are seen only by reflected light, and their colors vary in tint according to the position of the spectator, with respect to the plane of reflexion. For instance, in the normal of the plane of

reflexion, the color of bodies is most distinct; and at every deviation of this point the local tint changes, and, in many cases, is extinguished when the eye of the spectator reaches the angle of total reflexion. Thus, then, when the reflected light is the strongest, the color of bodies is least perceptible, and *vice versa*. These considerations induced me to try what comparative effects would be produced upon a sensitive surface by light reflected at various angles of incidence from the plane of the picture. The effects which were thus produced were analogous to those which are observed in nature; the local tints of the bodies represented varying with every change that was made in the angle of reflexion in which the picture was taken down, and the direct ray invariably gave less picturesque results then when a parallel glass was used. In some specimens taken with the parallel glass, when they were looked at directly, all the appearances of a radiating reflexion were presented; and, when looked at obliquely, all those of a specular reflexion, as if the sun were actually shining within the photographic picture itself. These results gave promise that some remarkable effects would be produced by polarized light: I, therefore, had a small sun-dial made, the style of which was formed by a bit of very fine silver wire; and from the centre of the dial a bit of the same wire was erected perpendicularly so that the hour angle and the sun's azimuth were given at the same instant. By means of this instrument, I was able to determine, with accuracy, the position of the sun with respect to the plane of the picture that I wished to make a photographic representation of; the glass of the camera was also made adjustable to the polarizing angle by an attached graduated quadrant. When, by these means, the light was polarized into the camera, by a double reflexion, from the plane of the picture and from the parallel glass, I found that the objects in deep shadow and those in sunlight were taken down simultaneously and with equal precision, without the slightest trace of solarization; exhibiting a sunlight view of the greatest truth and beauty, in which the transparency of the shadows, and the effect of distance produced by an exquisite gradation of tint, are such as Art could scarcely hope to imitate. This result of polarized light seems doubly interesting since the recent discovery of Mr. Faraday, where a ray of extinguished polarized light is re-illumined by electricity. How far this discovery may enable us to determine the nature of the active agent concerned in the production of the photographic picture, I will not, at the present moment, presume to decide." Trans. Soc. Arts, Jan. 21st.—Athenæum.

Cast Jewellery.

At the last exhibition at Vienna of metallurgic industry in Austria, the productions of M. Glanz, who had been attached for 15 years to the royal foundry of that capital, created general admiration. His art consists chiefly in producing cast jewellery, of a most surprising delicacy. They are cast in moulds formed of very fine sand—the patterns are in bronze, and worked with great care. The cast metal,

which is used, will have a great influence on the success of this operation. That which is chiefly employed at Vienna is obtained from Maria-Zell, in Styria,—or from the royal foundry, in the environs of Halle, in the Tyrol; it is a grey metal, very compact and homogeneous. This metal is put in fusion in crucibles of plombagine (lead and silver ore mixed together); it is run into moulds so well made that every portion comes out most perfect. The additions required to be made are, by rendering them ductile with powdered charcoal in a red heat for several hours, and afterwards finished by filing. This metal, becoming malleable, can be finely polished; but it is often washed with a black varnish, and then baked in an oven. These are chiefly used for mourning jewellery. M. Glanz is not confined by the same process to casting brass trinkets, but gold and silver, and other metals, by which he saves all the trouble of the chaser. The collection is very varied—bronze figures, brooches, bracelets, necklaces, snaps, buckles, buttons, scissors, &c. This jewellery is better known under the name of Berlin, and an immense quantity is annually imported into this country and France, which, being at so reasonable a price, has nearly superseded the Birmingham ware, and the manufactures of France, where they experience so much difficulty in obtaining the proper description of metal and fuel, and that at a very high price, so as to preclude them competing with those of Vienna, Berlin, and other parts of Germany, where the art in the improvement of metal has made great progress. Lond. Min. Journ.

On the Artificial Production of Diaphanous Quartz. By M Ebelmen.

When either of the two silicic æthers which I have recently described* is exposed to the continued action of a moist atmosphere, the liquid finally solidifies to a transparent mass. This product, very delicate and fragile in the first days after its solidification, contracts more and more under the influence of the moist air, still remaining diaphanous. Two or three months are requisite in operating on 5 or 6 grms. of æther, for the substance to cease to lose in weight and for its molecular movement to terminate. The substance prepared as above is hard, faintly scratches glass, and possesses great cohesion; its lustre, its fracture and transparency are perfectly comparable to the most beautiful rock crystal. Its density is 1·77. It is a hydrate, which contains twice as much oxygen in the silica as in the water, the formula of which is consequently $(SioO)^2$ HO.

It is essential, in order that the product may not become fissured during the contraction it experiences before attaining the definite formula $(SiO)^2$ HO, not to allow the moist air to enter except by an aperture of very small diameter. During the whole of the experiment the flask containing the silicic æther exhales an alcoholic odour, which persists a long time after the solidification, proving that only a portion of the organic matter had separated from the silica when the

* See Phil. Mag. vol. xxv. p. 397.

solidification took place. The contraction proceeds the more slowly the less easily the moist air is renewed in the apparatus, and this slowness appears indispensable to the success of the operation.

From the properties of the hydrate of silica, we may be allowed to hope that it may be turned to advantage in the construction of optical instruments. It is my intention to make some experiments in this direction. Comptes Rendus, Aug. 25, 1845.—Lond. Edin. & Dub. Phil. Mag.

Expulsion of Foul Air from Mines.

An engineer (M. Haland) has forwarded to the Academy of Sciences at Paris, a very interesting memoir on the expulsion of foul air from mines, pits, cellars, and similar places. It consists in the pumping of *steam* into places thus contaminated, which, if the foul air consists of hydrogen gas, acts merely as a forcible expeller; but if it be carbonic acid gas, the steam will also absorb that substance. As most places where deep excavations are now made, are near steam engines, the pumping of steam into mines, &c., becomes the easier. It is to be done through elastic tubes covered with india-rubber. The inventor states, that in a deep pit, where the work had been suspended by necessity for several days, the emission of steam purified it to that extent, that the workmen were able to go down as usual.

Civ. Eng. and Arch. Journ.

Proceedings of Royal Society, London.

Action of the Solar Spectrum on Vegetable Juices.—December, 1845.—In the experiments, of which the results are here reported, the solar spectrum was condensed by a lens of flint glass of seven inches and a half focus, maintained in the same part of the screen by keeping a pin-hole or pencil-mark constantly at the corner of the red rays, which were sharply defined by being viewed through blue spectacles; and the apparatus was covered with black cloth, in order to exclude extraneous light. Thick white letter paper, moistened with the liquid to be examined, was exposed wet to the spectrum, as it was found that the action of the colored light was thus rendered more immediate and more intense, than when the surface of the paper was dry. The action of the spectrum at the junction of the lavender with the violet rays, was found, in some cases, to be different from what it is with either of these colors separately, indicating a break in the continuity of action, and suggesting the idea of a secondary spectrum. In many instances the yellow and green rays exert a powerful influence on vegetable substances, an influence apparently unconnected with heat; for the darkening is generally least under the red rays, and immediately below them when the calorific rays are most abundant. The action in a great number of cases produces insulated spots in different parts of the spectrum, but more especially in the region of the rays of mean refrangibility, in which neither the calorific nor the chemical powers are the greatest. The maximum point of intensity is some-

times altered by the addition of acids, alkalies, or diluted alcohol. But altogether, as the authoress states, the action of the different parts of the spectrum seems to be very capricious, the changes of color produced being exceedingly irregular and unaccountable.

"*On New Magnetic Actions, and on the Magnetic Condition of all Matter.*" *By* Michael Faraday, Esq., D.C.L., F.R.S. &c.—The following is the order in which the several divisions of the subject treated of in this section of the author's researches in electricity succeed one another:—1. Apparatus required. 2. Action of magnets on heavy glass. 3. Action of magnets on other substances acting magnetically on light. 4. Action of magnets on the metals generally. 5. Action of magnets on the magnetic metals and their compounds. 6. Action of magnets on air and gases. 7. General considerations.

In giving an account of the contents of this paper, any attempt to follow the track of the author in the precise order in which he relates the consecutive steps of his progress in this new path of discovery, would fail of accomplishing its object: for, by adhering to such a course, it would scarcely be possible to comprise within the requisite limits of an abstract the substance of a memoir extending, as the present one does, to so great a length, and of which so large a portion is occupied with minute and circumstantial details of experiments; or to succeed in conveying any clear and distinct idea of the extraordinary law of nature brought to light by the author, and of the important conclusions which he has deduced.

One of the simplest forms of experiment in which the operation of this newly-discovered law of magnetic action is manifested, is the following:—A bar of glass, composed of silicated borate of lead, two inches in length, and half an inch in width and in thickness, is suspended at its centre by a long thread, formed of several fibres of silk cocoon, so as to turn freely, by the slightest force, in a horizontal plane, and is secured from the agitation of currents of air by being enclosed in a glass jar. The two poles of a powerful electro-magnet are placed one on each side of the glass bar, so that the centre of the bar shall be in the line connecting the poles, which is the line of magnetic force. If, previous to the establishment of the magnetic action, the position of the bar be such that its axis is inclined at half a right angle to that line, then, on completing the circuit of the battery so as to bring the magnetic power into operation, the bar will turn so as to take a position at right angles to the same line; and, if disturbed, will return to that position. A bar of bismuth, substituted for the glass bar, exhibits the same phenomenon, but in a still more marked manner. It is well known that a bar of iron, placed in the same circumstances, takes a position coincident with the direction of the magnetic forces; and therefore at right angles with the position taken by the bar of bismuth subjected to the same influence. These two directions are termed by the author *axial* and *equatorial;* the former being that taken by the iron, the latter that taken by the bismuth.

Thus it appears that different bodies are acted upon by the mag-

netic forces in two different and opposite modes; and they may accordingly be arranged in two classes; the one, of which iron is the type, constituting those usually denominated *magnetics;* the other, of which bismuth may be taken as the type, obeying a contrary law, and therefore coming under the generic appellation of *diamagnetics.* The author has examined a vast variety of substances, both simple and compound, and in a solid, liquid, or gaseous form, with a view to ascertain their respective places and relative order with reference to this classification. The number of simple bodies which belong to the class of magnetics is extremely limited, consisting only of iron, which possesses the magnetic property in an eminent degree, nickel, cobalt, manganese, chromium, cerium, titanium, palladium, platinum and osmium. All other bodies, when either solid or liquid, are diamagnetic; that is, obey the same law, with regard to magnetic action, as bismuth, but with various degrees of intensity: arsenic is one of those that give the feeblest indications of possessing this property. The following exhibit it in increasing degrees, according to the order in which they are here enumerated; namely, ether, alcohol, gold, water, mercury, flint glass, tin, lead, zinc, antimony, phosphorus, bismuth. On the other hand, no gaseous body of any kind, or in any state of rarefaction or condensation, affords the slightest trace of being affected by magnetic forces. Gases may therefore be considered as occupying the neutral point in the magnetic scale, intermediate between magnetic and diamagnetic bodies.

The magnetic properties of compound bodies depend on those of their elements; and the bodies are rendered either magnetic or diamagnetic, according to the predominance of one or other of these conditions among their constituent parts. Thus iron is found to retain its magnetic power when it has entered into combination with other bodies of the diamagnetic class; the two forces acting in opposition to one another, and the resulting effect being only that due to the difference in their power. Hence the oxides and the salts of iron are still in a certain degree magnetic, and the latter even when they are held in solution by water; but the water may be present in such a proportion as that neither shall prevail; and the solution, as far as respects its magnetic properties, will then be exactly neutralized. These saline solutions, prepared of various degrees of strength, also afford a convenient method of comparing the relative degrees of force, both magnetic and diamagnetic, of different bodies, whether solid or fluid, but more especially the latter, as they admit of the body under examination being suspended in another liquid, when its position of equilibrium will indicate which of the two substances has the strongest magnetic power.

In one respect, indeed, the diamagnetic action presents a remarkable contrast with the magnetic; and the difference is not merely one of degree, but of kind. The magnetism of iron and other magnetics is characterized by polarity; that of diamagnetics is devoid of any trace of polarity; the particles of two bodies of the latter class, when jointly under the influence of the magnetic forces, manifest towards each other no action whatever, either of attraction or repulsion. It has

long been known that the magnetism of iron is impaired by heat; and it has been generally believed that a certain degree of heat destroys it entirely. The author finds, however, that this opinion is not correct; for he shows that, by applying more powerful tests than those which had been formerly confided in, iron, nickel and cobalt, however high their temperature may be raised, still retain a certain amount of magnetic power, of the same character as that which they ordinarily possess. From the different temperatures at which the magnetic metals appear to lose their peculiar power, it had formerly been surmised by the author that all the metals would probably be found to possess the same character of magnetism, if their temperature could be lowered sufficiently; but the results of the present investigation have convinced him that this is not the case, for bismuth, tin, &c., are in a condition very different from that of heated iron, nickel or cobalt.

The magnetic phenomena presented by copper and a few other metals are of a peculiar character, differing exceedingly from those exhibited by either iron or bismuth, in consequence of their being complicated with other agencies, arising from the gradual acquisition and loss of magnetic power by the iron core of the electro-magnet, the great conducting power of copper for electric currents, and its susceptibility of being acted upon by induced currents of magneto-electricity, as described by the author in the first and second series of these researches. The resulting phenomena are to all appearance exceedingly singular and anomalous, and would seem to be explicable only on the principles referred to by the author.

Pursuing his inductive inquiries with a view to discover the primary law of magnetic action from which the general phenomena result, the author noticed the modifications produced by different forms given to the bodies subjected to experiment. In order that these bodies may set either axially or equatorially, it is necessary that their section, with reference to the plane of revolution, be of an elongated shape: when in the form of a cube or sphere they have no disposition to turn in any direction: but the whole mass, if magnetic, is attracted towards either magnetic pole; if diamagnetic, is repelled from them. Substances divided into minute fragments, or reduced to a fine powder, obey the same law as the aggregate masses, moving in lines, which may be termed *diamagnetic curves*, in contradistinction to the ordinary magnetic curves, which they everywhere intersect at right angles. These movements may be beautifully seen by sprinkling bismuth in very fine powder on paper, and tapping on the paper while subjected to the action of a magnet.

The whole of these facts, when carefully considered, are resolvable, by induction, into the general and simple law, that while every particle of a magnetic body is attracted, every particle of a diamagnetic body is repelled, by either pole of a magnet. These forces continue to be exerted as long as the magnetic power is sustained, and immediately cease on the cessation of that power. Thus do these two modes of action stand in the same general antithetical relation to one another as the positive and negative conditions of electricity, the

northern and southern polarities of ordinary magnetism, or the lines of electric and of magnetic force in magneto-electricity. Of these phenomena, the diamagnetic are the most important, from their extending largely, and in a new direction, that character of duality which the magnetic force was already known, in a certain degree, to possess. All matter, indeed, appears to be subject to the magnetic force as universally as it is to the gravitating, the electric, the cohesive and the chemical forces. Small as the magnetic force appears to be in the limited field of our experiments, yet when estimated by its dynamic effects on masses of matter, it is found to be vastly more energetic than even the mighty power of gravitation, which binds together the whole universe: and there can be no doubt that it acts a most important part in nature, and conduces to some great purpose of utility to the system of the earth and of its inhabitants.

Towards the conclusion of the paper, the author enters on theoretical considerations suggested to him by the facts thus brought to light. An explanation of all the motions and other dynamic phenomena consequent on the action of magnets on diamagnetic bodies might, he thinks, be offered on the supposition that magnetic induction causes in them a state the reverse of that which it produces in magnetic matter: that is, if a particle of each kind of matter were placed in the magnetic field, both would become magnetic, and each would have its axis parallel to the resultant of magnetic force passing through it; but the particle of magnetic matter would have its north and south poles opposite to, or facing the contrary poles of the inducing magnet; whereas, with the diamagnetic particles, the reverse would obtain; and hence there would result, in the one substance, approximation; in the other, recession. On Ampére's theory, this view would be equivalent to the supposition that, as currents are induced in iron and magnetics, parallel to those existing in the inducing magnet or battery wire, so, in bismuth and other diamagnetics, the currents induced are in the contrary direction. As far as experiment yet bears upon such a notion, the inductive effects on masses of magnetic and diamagnetic metals are the same.

"*On the Use of the Barometric Thermometer for the determination of Relative Heights.*" *By* James R. Christie, Esq.—*January 29th.*—The objects of this communication, as stated by the author, are, first, to show the theoretical foundation of the very simple law pointed out by Professor Forbes, according to which the difference of the boiling temperature of water at two stations is connected with their difference of level; and next, to test the accuracy of this law by a comparison of results deduced from his own observations on the boiling-point of water at different stations among the Alps of Savoy, Piedmont and Switzerland, with the heights of the same stations as determined by other observers and by different means; and thus to arrive at a just conclusion with respect to the value of the barometric thermometer as an instrument for determining differences of level.

Combining DeLuc's formula reduced to English units,

$$b = \frac{99}{\cdot 899} \log 10\,\beta - 60\cdot 804,$$

where b is the variable boiling-point on Fahrenheit's scale and β the corresponding barometric pressure, with the formula of Laplace for the determination of the difference in level of two stations from barometric observations, he obtains the formula

$$H = 547\cdot 99\,(b - b') \left\{ 1 + (t - 32^{\circ})\,\cdot 00222 \right\},$$

where b and b' are the boiling-points on Fahrenheit's scale at the two stations, t the mean temperature of the air at the stations, and H their difference of level in English feet.

The author describes the particular instrument he employed in his observations, and his mode of determining the correction which it required; and then gives, in a table, the observations he made on the boiling-point of water at thirty-eight different stations in the Alps; the heights of the corresponding stations above the sea level, deduced from these observations; and, for the purpose of comparison, the heights of the same stations deduced by other observers. The difference between these and some of the author's results are considerable; but as they are not greater than would probably arise from ordinary barometric measurements, and as there is a close accordance between his results and the determinations on which the greatest reliance can be placed, he concludes that the results are on the whole satisfactory. Considering it, however, desirable to obtain some test of the accuracy of each observation independently of the rest of the series, the author avails himself of the barometric observations made at the Observatory at Geneva and at the Convent of the Great St. Bernard; and determining from these the corresponding temperature of boiling water, deduces the difference of level between each of his stations and these two places considered as fixed points: the sum of the height above Geneva and the depression below the Great St. Bernard should in all cases be the difference of level between the two fixed stations. Although there are here again considerable discrepancies, yet in most cases, where the height of the station may be considered as well established, the height deduced from the observations agrees with it in a very remarkable manner.

In another table, the author gives the difference of level between the Observatory at Geneva and the Great St. Bernard, deduced from the recorded observations at those places simultaneous with his own at his various stations; and then remarks that the differences of height determined by the two methods do not differ from one another, in any single case, by so large a quantity as do the greatest and least differences of height deduced from the barometric observations; while in many cases the accordance is almost perfect.

The conclusion drawn from the comparisons in these tables is, that the barometric thermometer is capable of affording highly accurate and satisfactory results, perhaps even more so than the common form of barometer, but that there is considerable uncertainty attached to its

indications. This uncertainty, far from being wholly attributable to the imperfections of the instrument as a measure of the atmospheric pressure, might, the author thinks, arise from an extreme susceptibility to rapid changes in that pressure, which remain unindicated by the more sluggish barometer.

"*On the Electro-Chemical Protection of Metals.*"—*Jan.* 30.—The chief subject of Prof. Brande's communication was, the description and philosophical explanation of the protection given to iron by coating it with zinc. The researches of Sir H. Davy in the years 1824–25 were noticed, and the effects of sea-water on copper, simply immersed in that liquid, were contrasted with the protection afforded to it by a cemented plate of zinc or iron. It was then demonstrated that, whenever two metals, possessing unequal affinity for oxygen, are brought into metallic contact in any medium containing oxygen, an electrical current is produced; that this current passes from the more oxidizable to the less oxidizable metal; and that the latter is protected by the increased corrosion of the former. Thus, the interior of a copper stew-pan will not be affected by acids so long as any of its tinning remains; while, on the contrary, if what is called tinplate (*i. e.* iron plate coated with tin) be scratched, however slightly, the iron is quickly corroded, the cuticle of tin being protected at the expense of the metal which it was designed to preserve. Now, *zinc* on *iron* is what *tin* is on *copper*,—a perfect protection, so long as any remains on its surface. It was then shown that, generally, the direction of an electric current depended, not only on the metals, but on the nature of the medium through which the current passed (*e. g.* on whether an acid, or a solution of sulphur, or of any other electro-negative substance was used.) Instances of metallic deposition by chemical affinity, as that of lead on zinc, of copper on iron, &c., were exhibited; and it was shown that, whenever the electric current was superinduced by the employment of a conductor of electricity, whether metallic or not, the metal passed to the conducting (or the electro-negative) surface (the cathode of Faraday.) The process of zincing iron was then exhibited. The metal is carefully scoured, steeped in dilute acid, washed in water and thoroughly dried, and then plunged into melted zinc. As it is necessary that there should be perfect metallic contact between the metals, sal-ammoniac is sprinkled over the melted zinc before the immersion of the iron. This covers the liquid metal with a film of chloride of zinc, which precludes intervening oxide, and thus insures perfect adhesion between the coating and coated metals. Prof. Brande concluded his communication by exhibiting zinced iron piping, and by mentioning instances of the successful application of this invention, as in the cases of the iron roofing of the Houses of Parliament, the buoys used by the Trinity House, wires of galvanic telegraphs, &c.

"*On the Influence of the Solar Rays in producing Chemical or Molecular Change*".—*Feb.* 13.—Having briefly sketched the progress of philosophical inquiry into the chemical influence of the solar

ray from the original researches of Daguerre and Talbot, Mr. Hunt proceeded to develope his own views in regard to the prismatic spectrum. Hastily noticing the well known phenomena of light and heat as connected with the solar ray, the lecturer dwelt on its property of producing chemical change. This change was exhibited in preparations of silver and in the coloring matter of leaves: and then the molecular disturbance produced on metals under the influence of the spectral rays was described. Having shown by means of diagrams, and experimentally with the oxy-hydrogen light, that the chemical power was least at that part of the prism where the luminosity was greatest, and that, generally, the one influence increased as the other diminished, Mr. Hunt inferred, that, to obtain perspicuity in scientific language, it would be advisable to distinguish, by some specific appellation, a quality of the solar rays, so clearly different from that of producing light or heat. The term *actinism* had been suggested to express this property, and, as it involves no hypothesis, it was considered provisionally useful. Examples were then adduced to show that the luminous rays acted as antagonist forces to the *actinic* rays, and that the chemical change produced by heat was of a totally different character from that caused by *actinism*,—a force which, though acting in every part of the spectrum, was most powerful beyond the limits of the influence of light and heat. Numerous examples were then adduced to show that chemical change, so far from being confined to a few so called photographic agents, was produced on an immense variety of compound and simple bodies. In addition to the salts of silver, gold and iron, specimens of pictures produced by the sunshine on the salts of nickel, cobalt, tin, mercury, bismuth and copper were shown, together with evidences of molecular change on plates of polished copper and tin, wood, stone, and glass. The results of these experiments being—1. That every substance in nature exposed to solar light undergoes a change. 2. That all substances have the property of restoring themselves to their original condition when this influence of solar light is removed. Therefore, the hours of darkness become not less important to the inorganic than they are to the organic creation. Among other remarkable phenomena, demonstrative of the mutually antagonist tendencies of the *actinic* and luminous spectrum in producing chemical decomposition, Mr. Hunt particularly instanced the feeble chemical power of the sun's rays in those parts of the world where their luminous and calorific power is greatest, as in South America, Egypt, &c.,—the change in simple and compound solutions produced by exposure to sunshine, the development of dormant images caused by the solar ray, their obliteration, and subsequent restoration. In conclusion Mr. Hunt avowed his conviction that philosophers were progressively attaining the knowledge of a power in nature superior to the so-called Imponderable Agents to which the great phenomena of the universe have hitherto been mainly referred, and which, in all probability, are but manifestations of this unknown power modified by agencies which themselves must be the subject of future research.

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CIVIL ENGINEERING.

Extracts from the Report of Napoleon Garella, *an Engineer appointed by the French Government to survey the Isthmus of Panama. Translated for the Journal of the Franklin Institute by* Persifor Frazer, Esq.

(Continued from page 24.)

Line and Principal Features of the Projected Canal.

Dimensions of the Canal.—The communication to be opened between the two oceans, considered in its relation to general commerce, and more particularly to the interests of Europe, should be such that a vessel leaving France or England may proceed directly by this route to Peru, Chili, or even to China. Although the distance from Europe to Canton by the isthmus of Panama is longer than by the Cape of Good Hope, it is probable that were the Canal of Panama cut, the route would be preferred in going to China, both on account of the regularity of the trade winds, which blow from east to west, and on account of the easy navigation of the great Pacific Ocean—circumstances which would render the passage shorter by Panama than by the Cape of Good Hope. This last route would then be followed only in returning from China to Europe.

The Canal of Panama should therefore be constructed in a manner to admit vessels capable of making the longest voyages, those of circumnavigation, and, consequently, merchantmen of the largest size.

Sailing vessels of commerce of 1200 tons may be assimilated, as regards their dimensions, to frigates of the second class, and of 52 guns; I cite here frigates merely as a point of comparison and a fixed standard, whose dimensions can be more precisely ascertained than those of merchantmen, which present more diversity. It appears to me that, in the execution of a work destined only to industry and commerce, which live only by peace, and whose progress is arrested by war, that we should not take ships of war at all into consideration. One may easily conceive the enormous increase of expense required, in the augmentation of all the dimensions of a canal, and of its necessary constructions, so as to admit vessels of 120 guns, expenses for which there could not be a sufficient compensation derived from the passage from time to time of some rare vessels of that size.

France possesses but few merchantmen of 1200 tons—her whalers range generally from 500 to 600; but England, whose marine is more considerable, possesses many, particularly those of the East India Company, which make regular voyages. Although these large ships are exceptions as regards the great number of smaller ones, (exceptions, however, which may in future become more rare as commerce with distant countries extends itself,) yet they should be allowed to take advantage of the benefits of a route of communication of such universal utility, and one established entirely in the interests of commercial relations.

The principal dimensions of ships of 1200 tons, or rather of frigates of the second class, to which they may be assimilated, are as follows:

	Metres.	Feet.
Length on deck,	53·50	(175.50)
Length, including cutwater and taffrail,	60·40	(198·00)
Width, including outside planking,	13·78	(45·21)
Maximum draught of water when laden,	6·50	(21·33)

Their displacement of water in *metrique tons* of 1000 kilogrammes, (2205 lbs. avoirdupois,) is 2352, the half of which representing the capacity for cargo is 1176, (1158 English tons,) nearly 1200 tons.

These dimensions, with the exception of the draught of water, are much surpassed by those of the large transatlantic steamers that have been constructed within a few years, which are the following:

	French Steamers.		English Steamers.	
	Metres.	Feet.	Metres.	Feet.
Length on deck,	72·10	(236·56)	72·20	(236·88)
Width,	12·05	(39·53)	11·10	(36·42)
Width outside wheel-houses,	18·05	(59·22)	17·10	(56·00)
Draught of water,	6·05	(19·85)	6·20	(20-34)

These exceed, both in length and width, the largest men-of-war; a canal of a size to receive these enormous steamers would require but a slight increase in depth to admit vessels of war of 120 guns; its width and the size of its locks would be much greater than those of a canal for sailing vessels of 1200 tons, and this difference of dimensions would necessitate so great an increase of expense in its construction, that it becomes worth our while to examine whether the advan-

tages to be derived from the passage of steamers across the isthmus of Panama are of a nature to induce us to encounter this increase of expenditure.

The object of the work across the isthmus of Panama is, as I have already said, to abridge the voyage between Europe and the western coast of America and China, without the necessity of transhipping the cargo, an operation always attended with loss of time and considerable waste and expense. But this transhipment which commerce so much dreads for merchandise, is without any appreciable inconvenience for travelers and for the mails, as regards the advantages which result from rapidity of transport. Actually, steam-packets, even those of the greatest tonnage, are hardly sufficient for the transport of their provision of fuel for a voyage of from 20 to 22 days. In fact, they carry nothing but passengers, the mails, and a little valuable merchandise of small bulk. Nothing that composes their cargo would find a serious inconvenience in transhipment. A small steamer for the service of the canal alone, and of such dimensions as to enable her to pass locks for vessels of 1200 tons, might receive the passengers and despatches at one entrance of the canal, and carry them with rapidity to the other extremity. The small loss of time which would be occasioned by each transhipment would really be inappreciable in a voyage, whose minimum length would be from 40 to 50 days. Nothing, then, in the actual state of things, appears to indicate the utility and advantages of the passage of large transatlantic steamers through a canal established across the isthmus of Panama. If we reason, in anticipating the progress that the art of naval constructions may make, and wish to provide for the period when the consumption of fuel by steamers may be so much diminished as to enable them to transport merchandise, we may also anticipate the moment probably less distant, when the screw will replace the large wheels in use at present, and when, consequently, steamers may be reduced to the dimensions of a frigate of 52 guns.

These considerations have decided me, in determining the dimensions of the canal, to take as a base, those of vessels which I have given above, without having regard to steamers, except those whose size will permit them to pass through the locks.

Canals on which business is not very active, may be made so as to allow but of the passage of a single boat, by establishing at certain distances turnout docks, for the passage of boats going in an opposite direction. For the canal of Panama, which would be at once much used, and for which we should anticipate a considerable increase of business, in the future, I shall propose such dimensions as will permit two large vessels to pass each other, throughout its whole length, with the exception of the deep cut or tunnel which will be necessary at the summit-level for the purpose of lowering it as much as possible. With this in view, and taking as a base the dimensions of frigates of 52 guns, as given above, I shall propose for the canal the following dimensions:

	Met.	Eng. ft.
1st, Depth, exceeding only by 0·50 m. (1·64 feet) the maximum draught of water of the largest vessel to pass the canal, ...	7	(23·00)
2d, Width at the water-level, (where the cutting is through earth,)	45	(147·64)
(a little more than 3 times the width of the largest ship.)		
Width at the bottom, ...	20	(65·61)
Width at the level of the tow-path, 1 metre above the water level, ...	48	(157·48)

The banks having an inclination of $1\frac{1}{2}$ of base for 1 of height, with a berm 2 metres (6·56 feet) wide, at a depth of 1·50 m. (4·92 feet) for arresting the washings of the upper portions.

The tow-paths on each bank should be 6 metres (19·68 feet) wide, with a reduction to 4 metres (13·12 feet) in the cuts.

3d, In the rocks, where the talus would require but the trifling inclination of a tenth, the width would be

	Met.	Feet.
At the water-line,	40·00	(131·23)
At the bottom,	38·60	(126·62)
At the level of the tow-path,	40·20	(131·88)
And including the tow-path,	48·20	(158·13)

4th, Finally, in the deep-cut of the summit-level, which will admit of the passage of but one vessel, I propose as follows :

	Met.	Feet.
Width at water-line,	17·00	(54·75)
Which, with the talus inclined 1 tenth, will give width at the bottom,	15·60	(51·18)
Width at the level of tow-path,	17·20	(56·43)
Width including tow-path,	21·20	(69·55)

In this portion, where two ships going in opposite directions cannot be admitted at the same time, one tow-path will be sufficient. The reasons that have led me to propose these dimensions are founded, on the one side, on the fact, that the economy resulting from the reduction of the canal to the width requisite for the passage of a single vessel, constructing at the same time in each level a *turn-out* dock, would be very trifling as regards the total expense ; and, on the other side, on the contrary, this expense would be considerably augmented, in giving to the deep-cut of the summit-level the width of the ordinary cuttings through rock, nearly doubling its cost, which forms already a considerable proportion of the total expense.

As for the locks, their dimensions are indicated by those of the largest ships which are to pass through them; they are as follows:—

	Met.	Feet.
Width,	14·20	(46·58)
Length between the gates,	64·00	(209·97)

These dimensions will allow of the admission, at the same time, into the lock, of two ships of 300 tons, having a maximum length of

35·50 metres, (116·47 feet,) including the cut-water and taffrail, and a width at the midship frame, including the outside planking, not exceeding 9·15 metres, (30·02 feet)—or two gun-brigs of 16 guns, whose length is 34 metres, (111·55 feet,) and breadth 8·96 metres, (29·40 ft.,) or finally, two lighters of 380 tons, having a length of 35·90 metres. (117·78 feet,) and a width of 8·48 metres, (27·82 feet.)

The preceding dimensions are about one-fifth greater than those of the Caledonian canal, the largest of existing canals, built so as to admit the passage of frigates of the 3d class; its depth of water is 6·10 metres, (20 feet,) its width at the water-line 37 metres, (122 feet,) and at the bottom 15·20 metres, (50 feet;) its locks have a width of 12·20 metres, (40 feet,) and a length of 52·40 metres, (172 feet.)

Point of Partition.—Of all the questions which arise in tracing the line of a canal which is to cross a ridge elevated above its two extremities, the most important, without doubt, is the determination of the point of partition; for on its height and position depend, in the first place, the number of locks to be constructed on each slope, which number has a most important influence both on the expense of the work and on the length of time necessary for navigating it; and secondly, what is of still greater importance, the facilities for supplying it with water. The first duty to which my attention was called was, therefore, the search of a point for traversing the chain of mountains which runs through the middle of the isthmus for its whole length. (M. Garella then goes into a detail of his examination of the different hills offering a favorable appearance for carrying across the canal, which I omit; he then continues,)

One may see from the preceding that all the points of passage observed are either of a greater height than the hill of Paja, or but little inferior to it.

Although it is always in the neighborhood of the lowest portion of the ridge that we should seek the point of partition of the canal, the height of this point is not always the only consideration which should determine us; the considerable labor in general necessary, to lower as much as possible the summit-level, and which the particular configuration of the ground may render more or less easy, may furnish us, in that configuration itself, with sufficient motives to avoid the lowest hill. In the particular case before us, it may be seen by the plan of the valleys, which the leveling, passing over the hill of Paja, has followed, that although the line of the canal is kept in the valleys of the Bernardino, on the one part, and of the Rio Paja on the other, it will not be by the hill of Paja that it must pass, but by that of Ahogayegua, situated 3500 metres (2·17 miles) to the west, this point being much more suitable for a deep-cut, which, without being of great length, will permit us to diminish considerably the height of the summit-level.

These different considerations determine me to adopt definitively the basin of the Bernardino for the route of the canal, and amongst the valleys of this basin that which ends at the hill of Ahogayegua. to which corresponds on the northern slope a little brook tributary to

the Rio Paja. The position of this hill was determined precisely by means of trigonometrical observations, made at the Cerro Tigre, at Lomalta, and in the Savannahs of the Bernardino; its height could not be determined as exactly, but the examination of the chain observed from the Cerro Tigre, before the adoption of any line for the passage of the canal, induced me to judge it of nearly the same height as that of Paja. The relative position of these three points induces me to think that this conclusion cannot be far wrong; nevertheless, to avoid an error in favor of the route I propose, I have thought it right to put down the hill of Ahogayegua as a little higher than that of Paja, and have assumed as its height 140 metres, (460 feet.)

In examining a transverse section of the central chain of the isthmus, from the Bernardino to the Rio Paja, in passing by the hill of Ahogayegua, the line I propose for the canal, it will be seen how favorable is the ground for a great deep-cut, or even a tunnel. At a height of 56 metres (183·73 feet) above the level of the highest tides of the Pacific, and at a depth of 84 metres (275·60 feet) below the summit of the hill, which depth appears a suitable limit for a deep-cut, the distance between the Bernardino and the Rio Paja is but 6650 metres, (4·13 miles.) If we should lower still more the line, and descend to height of 41 metres (134·51 feet) above the sea, and 99 metres (324·81 feet) below the summit, the distance between the two streams increases but little, and is only 8000 metres, (4·97 miles;) this depth below the summit appears to me too great for a deep-cut, although its length is not excessive; but a tunnel might be carried through, which, preceded by trenches of from 45 to 50 metres (147 to 164 feet) in depth, would be reduced to a length of from 5 to 6 kilometres, (3·10 to 3·72 miles,) nothing very formidable to the engineer in the actual state of science.

Those who have hitherto treated of the subject of navigation across the isthmus of Panama, have appeared to reject entirely the idea of a subterranean passage for a canal destined to be navigated by the largest ships. M. Michel Chevalier, to whom we are indebted for an excellent work on the different projects of communication between the two oceans, is of this opinion; he says,—"The character of a maritime canal interdicts all tunnels." I was myself a long time of this opinion, but many skilful and distinguished engineers whom I have had occasion to consult, appearing to think differently, I thought it my duty to examine the question from this point of view.

Two great objections may be made against the construction of a tunnel for a canal like that which should be carried across the isthmus of Panama; the first, founded on its enormous transverse dimensions, has reference only to the difficulties of its construction; this is within the province of science, and engineers alone are the proper persons to reply to it. The second refers rather to the use of the tunnel after it has been constructed, as relates to the difficulties and the slowness of the manœuvres to be executed in passing it, (for, however great its height may be, large vessels can never enter it without sending down their topmasts; and, finally, it is founded upon the repugnance, doubtless, to be overcome, in a large proportion of

mariners, against being carried through a passage where they will be deprived for some time of the light of the sun. Sailors only can refute completely this objection. I may observe, however, that there are but few canals of internal navigation, with a point of partition, that have not a tunnel, and some of them much longer than that required by the central chain of the isthmus; in this case there would be but the difference of the proportions of the canal and the tonnage of the ships; on the other side, the manœuvre of sending down the upper masts is often executed at sea without great difficulty or loss of time; the performance would be much easier and much shorter upon perfectly tranquil water; moreover, the tunnel, allowing the lowering of the summit-level to a much greater extent than a deep-cut, the time lost in sending down the masts would be compensated by that gained in the passage of a smaller number of locks, for there would be so many less to pass as would be required by the difference of level between the deep-cut and the tunnel.

I submit here the proportions which I would propose for the tunnel. The bed of the canal remaining the same as in the deep-cut, allowing but of the passage of a single vessel, the width on the level of the tow-path 1 metre above the level of the water, would be 21·20 metres, (69·55 feet.) The height of the lower masts of a frigate of 52 guns is 25 metres (82 feet) above the surface of the water, but the topmasts, when lowered, always surpassing them a little in height, it will be proper and quite sufficient to make the top of the tunnel 30 metres (98·42 feet) above the level of the water, and 37 metres (121·38 feet) above the bottom. Finally, as the hull of the ship is elevated but a few metres above the water, and in the upper portion there will be nothing but the masts, for the passage of which a great width is not necessary, it will be possible to diminish considerably the transverse section of the opening, and consequently the number of cubic feet of material to be excavated, by giving it the form of an ogive, (a pointed arch.) Notwithstanding this form, its section, on account of the great vertical and horizontal dimensions, as above mentioned, will still be considerable, and will amount to 596 square metres, (713 square yards;) but expense of time and money apart, the difficulties presented by its execution will not be in proportion to its great dimensions. This tunnel will be cut through hard and compact rocks of crystaline hornblende, (amphibolite,) which will certainly not require to be sustained by an arch, and for which a simple revetement in brick will be sufficient, even should that be necessary. The construction of a tunnel is not, in the present age, a work before which the science of the engineer hesitates; the augmentation of the section does not augment the difficulties except in an unsolid or friable material, which it is necessary to arch, but when, as in the present case, the material is compact and solid, the increase of section rather facilitates the execution. On the other hand, a tunnel offers, in comparison with a deep-cut, the advantages of diminishing considerably the expenses of execution, of lowering the summit-level, and thus facilitating the supply of water, and of diminishing the number of locks, and allowing of their more convenient distribution on the two slopes

of the chain, of which the southern particularly is very short. All these advantages,—which will be still further developed in the following pages, and against which the only objections that can be brought are the practical ones, as regards the passage of vessels, for the difficulties of execution appear to me to be such as may be easily overcome—have determined me to present simultaneously for the lowering of the summit-level, a deep-cut, and a tunnel, for the purpose of furnishing all the necessary elements to those who will be called upon to decide the question, which appears to me to enter into the province, as well of sailors as of engineers.

Summit-level with a Tunnel.—The tunnel may be placed so that its bottom shall be 41 metres (134·51 feet) above the ocean, and 99 metres (324·86 feet) below the summit of the hill, and the level of the water 48 metres (157·48 feet) above the ocean, that is, the highest spring-tides according to the observations at Panama. It would be preceded by trenches, at either end, ceasing at the point where, on account of the height of the ground, there would be an equality between the expenses of trenching and tunneling ; this height is about 46 metres, (150·92 feet ;) the length of the tunnel would thus be reduced to

	5350 met.	(5851 yds.) ($3\frac{1}{3}$ mls.)
Trench on the southern slope,	1570 "	(1717 "
Do northern do,	810 "	(886 "
Total length of the summit-level,	7730 "	(7454 "

Difference of Level to be overcome.—The difference of level to be overcome on the Pacific slope, is 48 metres (157·48 feet) in placing the lower level at the height of the highest tides. It can be overcome by 16 locks of 3 metres (9·84 feet) each, to which must be added a guard lock at the point of junction with the ocean : in all 17 locks. The difference of level on the Atlantic slope is greater ; an accurate leveling, made with the spirit-level, from one sea to the other, establishes the fact, that the highest spring-tides of the Pacific Ocean, at Panama, are 5·82 metres (19·09 feet) above the highest tides of the Atlantic at Chagres. As the highest tides at Panama are 6·10 metres, (20 feet,) whilst those of the Atlantic are but 40 centimetres, (15·75 inches,) this difference of level is reduced, at the moment of the lowest spring-tides, to 12 centimetres, (4·72 inches.) From these figures the mean level of the Pacific will be 2·97 metres (9·74 feet) above that of the Atlantic ; but the mean level of the Pacific is not constant ; the lowest tides have a height but of 2·75 metres, (9·02 feet ;) and their maximum is 1·90 metres (6·23 feet) below the maximum of the spring-tides ; their mean level is then 3·275 metres (10·745 feet) below the maximum of these last—*0·125 metres (4·92 inches) below their mean—and only *2·845 metres (9·334 feet) above that of the Atlantic. In taking a mean of all these tides this last number becomes *2·908 metres, (9·54 feet,) and will express the difference of

* *Note by Translator.*—My calculations make the three numbers marked thus * respectively,—0·225 metres, 2·745 metres, and 2·928 metres.

the mean heights of the two oceans. The difference of level to be overcome on the Atlantic slope is then 54 metres, (177·16 feet,) (48, + *6·02, the difference between the highest water of the Pacific and the lowest water of the Atlantic,) which will require 13 locks, of 3 metres lift each, like those on the Pacific slope.

Distribution of the Locks on the Pacific Slope.—The canal on this slope is, properly speaking, but a lateral canal of the Bernardino, which it follows on its left bank, to its junction with the Caimito—its greatest distance from the stream being 700 metres, (765 yards.) The canal crosses in this interval, upon aqueducts, two of its principal branches, the Rio Copé and the Rio Aguacata. Below the mouth of the Bernardino the canal follows, for some time, the left bank of the Caimito, then turns towards the east, and passing along the shores of the ocean, debouches about 4 kilometres (2·48 miles) from the mouth of the Caimito in the little bay of Vaca du Moite. The length of this branch is 13,450 metres, (8·35 miles.)

The distribution of the 16 locks along this distance of 13,450 metres, gives to the levels a mean length of 840 metres, (918 yards.) But one canal, that of Rochdale in England, offers an example of a near approachment of its locks. Their mean distance is 520 metres, (569 yards.) The shortness of the levels of a canal is an inconvenience in navigation whenever its depth is affected by the introduction or loss of a lock of water; (the quantity lost by the passage of a vessel through the lock.) For the canal of Panama, the volume of a lock of water would be 14·20 metres, $\times$ 64 metres, $\times$ 3 metres, $=$ 2726·40 metres cub. (96260 cub. feet.) The width of the lock being one-third of that of the canal, the depth of a level of 775 metres (847·59 yards) in length, would vary one-twelfth of a metre, (3·28 inches,) by the introduction of the contents of a lock, a variation altogether insignificant. There would be then no inconvenience from this great approachment of the locks, if the slope upon which the canal is placed were uniform, and they could be placed at equal distances; but, unfortunately, the declivity of the ground, which augments considerably as we approach the highest point, obliges us in this portion to diminish the distance between the locks and the length of the levels. A steep declivity may be overcome either by single locks separated by short levels, or by groups of locks separated by longer levels. This last system has been adopted at the locks of Fontserane, on the *Canal du Michi*, and at several points on the Caledonian canal, of which the famous Neptune's stair-case is a remarkable instance, where eight adjoining chambers, occupying a length of 457·20 metres (500 yards,) having a total lift of 18·29 metres, (50 feet.) These united locks, though a little more economical in construction, present the disadvantage of a greater consumption of water, and the still greater one of stopping the progress of vessels going in opposite directions when they meet in the neighborhood of the group of locks. Single locks separated by short levels, have the first disadvantage in a much smaller degree, and always permit the

* This should be 6·22.—*Translator.*

passing of vessels in the levels. From these motives I have thought it preferable to reject the plan of grouping the locks, and to adopt the short levels. The lock terminating the summit-level on the side of the Pacific ocean, is followed by five levels, each 180 metres, (196·85 yards,) including the lock. The 6th level, of 450 metres, (492·13 yards,) carries the canal across the Rio Copé upon an aqueduct; the 7th, 8th, 9th and 10th, are each 500 metres (546·81 yards) long; the 11th is 1000 metres, (1093·63 yards;) the 12th and 13th 3000 metres, (3281 yards;) the 14th and 15th 1000 metres, (1093·63 yards;) and the 16th 1100 metres, (1203 yards:) in all 13450 metres. In level No. 12, the canal passes by a second aqueduct over the Rio Aguacata. The maintenance of a sufficient height to pass this stream renders it necessary to construct a portion of the level with embankments.

Line and Distribution of Locks on the Atlantic Slope.—On the Atlantic slope, starting from the summit-level, the canal follows the valley of the Rio Paja, called, further down, the Rio Bonito, to the point where it empties into the Caño Quebrado, which last it crosses by an aqueduct; in the lower part of the valley the line follows the right bank, separating a little from it, with the object of reducing the height of the embankments to be made in approaching the aqueduct. After the passage of the Caño Quebrado, it enters by a cutting of 18·35 metres (60·10 feet) maximum depth, into the valley of the Rio Gigante, which it follows, crosses the stream on an aqueduct, enters by a cutting of 20·80 metres (68·23 feet) maximum depth, into the little valley of Palenquilla, which it passes, by an embankment 6·50 metres (21·32 feet) in height, at a short distance from the hamlet, and arrives, by a final cutting of 22 metres (72·18 feet) maximum depth, at Varro Colorado, on the banks of the Rio Chagres, 21200 metres (13·18 miles) from the northern lock of the summit-level. From this point the canal follows, laterally, the Rio Chagres, without encountering any great difficulties in the ground, until it arrives opposite the little village of Dos Hermanos, 700 metres (765·56 yards) above the mouth of the Rio Trinidad. At this point the effects of the tide of the Atlantic are perceptible; the current is feeble, even null, at high water, except at the period when the river is flooded. Below this the depth in general considerably varies from 3 to 6 metres, (10 to 20 feet,) and increases in some places to 11, 12, and even 18 metres, (36, 39 and 59 feet.) The width increases from 60 to 70 metres, (65 to 77 yards,) which it has at Gatine, and to 110 metres (120 yards) at Chagres. It may therefore be easily made subservient to the navigation by straightening some short bends that are met with.

The total length from the northern lock of the summit-level to the lock opening into the river, opposite Dos Hermanos, is 33560 metres, (20·85 miles.) The difference of level to be overcome, of 54 metres, (177·16 feet,) gives, with locks of 3 metres (9·84 feet) each, a mean length of 1962 metres for the levels, considerably more than on the southern slope; but on this side, as on the other, the increased steepness of the descent in the vicinity of the summit, compels us to place

the locks more together in the upper portions, though not so near as to produce any inconvenience. The length of the levels are as follows:—

	Met.	Yards.
No. 1, . . .	750	(820·24)
" 2, . . .	630	(689·00)
" 3, . . .	640	(699·92)
" 4, . . .	925	(1011·61)
" 5, . . .	750	(820·24)
" 6, . . .	700	(765·56)
" 7, . . .	750	(820·24)
" 8, . . .	775	(847·57)
" 9, . . .	15150	(16568·47)
" 10, . . .	700	(765·56)
" 11, . . .	890	(973·32)
" 12, . . .	910	(995·20)
" 13, . . .	1800	(1968·53)
" 14, . . .	5250	(5741·50)
" 15, . . .	1000	(1093·63)
" 16, . . .	930	(1017·07)
" 17, . . .	1010	(1104·56)
Total, . .	33560	(36702·32)

Level No. 9 is that which offers the greatest difficulties, and demands the most labor and expense. It will require two aqueducts over the Caño Quebrado and the Rio Gigante, a third, smaller, over the rivulet of Palenquilla, the deep-cuts through the ridges separating the valleys of the Caño Quebrado and the Rio Gigante. This last from Palenquilla, and Palenguilla from Varro Colorado, and finally the embankments necessary for the passage of the canal through each of these three valleys. Below this level, the difficulties of the ground require but one considerable embankment at Varro Colorado, and three small aqueducts over the two brooks opposite Agua Salud, and that opposite Peña Blanca. To resume, the whole length of the canal between the Pacific ocean and the river Chagres at Dos Hermanos, is 54740 metres, (34·01 miles,) to wit:—

	Met.	Miles.
Summit-level, ...	7730	(4·80)
Southern branch, ...	13450	(8·36)
Northern branch, ...	33560	(20·85)
Total, . .	54740	(34·01)

The stream of the Chagres may be, without any great expense, converted into an excellent and magnificent canal, for the whole of its length, between Dos Hermanos and its mouth, but the necessity of being able to enter at all times without difficulty or danger into a maritime canal cut across the isthmus of Panama, the obstructions found at the mouth of the Chagres, the difficulty, not to say the impossibility, of removing them, the uncertainty of the result of works

for that purpose, and finally, the neighborhood of the bay of Limon, which affords to ships a great depth of water, have led, a long time since, as I have already said, to the selection of this bay as the point of arrival of the route of communication destined to connect the two oceans. As this opinion appears to me well founded, I cannot do otherwise than accede to it; it is, therefore, on the western shore of this bay, at about the middle of its length, that I propose to place the Atlantic embouchure of the canal. It becomes then necessary to establish a communication between the bay and the river Chagres.

The bottom of the bay is only distant in a straight line from some portions of the river, about 3500 metres, (3827·71 yards.) In this portion the ground has but few irregularities, and in some points, particularly between the bottom of the bay and the river Gatine, which flows from east to west, and empties into the Chagres, a little above the village of Gatine, the irregularities disappear almost entirely, and give place to a nearly flat surface. The irregularities of the ground can be judged of from the summit of the Cerro de Gatine, where I established a trigonometric signal, situated 2200 metres (2406 yards) from the mouth of the Gatine, and only 6000 metres 6561·37 yards) from the bay. I have, unfortunately, no precise observations which can serve me as a base for tracing the line of the canal in this part of the isthmus, and have nothing more than approximative results to offer; nevertheless, in confirmation of my observations of the slight elevation of the ground, I may cite a fact well known in the village of Gatine, which is, that its inhabitants, who make frequent voyages to the bay of Limon, for the purpose of gathering the fruit of the numerous cocoa-trees which cover the flat at the head of the bay, are said in the rainy season to ascend the stream to a certain point in light canoes, which they then drag through the mud across the land, and descend in them on the other side to the bay. I know that great faith is not always to be given to these popular statements. The opinion of Mr. Lloyd, however, confirms them; he expresses himself as follows upon the probability of a junction between the bay and the Chagres:—"The distance of one of the best harbors (as regards anchorage) across the land which separates it from the river Chagres, and by the most suitable route, is a little less than 3 miles. I have passed over the ground separating them: it is remarkably level, and in all respects suitable for a canal, which, being required for so short a distance, may be excavated with a depth sufficient to admit vessels of a reasonable draft of water, and will obviate the difficulty of a want of sufficient water at the entrance of the Chagres."

The canal which I propose will have its entrance upon the right bank of the Chagres, a little below the mouth of the Gatine. This entrance will be protected by a guard-lock against the inundations of the river. The line will follow the valley of the Gatine, ascending it to the point of depression of the ridge, a point which I believe I exaggerate in fixing its maximum elevation at 20 metres (65·62 feet) above low water of the Atlantic; it then turns towards the north, crosses the ridge, and arrives at the bottom of the bay of Limon, along which it runs on its western shore, even penetrating into the bay for

a certain distance, and finally about midway of its length opens into the sea, after passing over a distance of about 12400 metres, (13561 yards,) (7·70 miles.) This portion of the canal, consisting entirely of excavations, even where it enters the bay, which must be deepened, offers no difficulty of execution; the cutting necessary for the passage through the ridge will have a maximum depth of 20 metres (65·02 feet) to the surface of the water; and for a length of 3000 metres (3281 yards) its depth will not exceed 10 metres, (32·81 feet.)

The distance from Dos Hermanos to the mouth of the Gatine along the actual course of the Chagres, is 11800 metres, (12904·86 yards,) (7·33 miles;) by the cuttings necessary to render the river easily navigable, this distance will be reduced to 9310 metres, (10181·71 yards,) (5·785 miles.) The total length of the line of navigation between the two oceans, will then be 76450 metres, (83608·24 yards,) (47·50 miles,) to wit:—

		Met.	Miles.
Artificial Navigation.	Between the Pacific and the Chagres,	54740	(34·01)
	" " Chagres and Bay of Limon,	12400	(7·70)
	Together,	67140	(41·71)
Natural Navigation.—The River Chagres,		9310	(5·79)
	Total,	76450	(47·50)

(To be continued.)

Summary of Results offered, in conjunction with one by William Fairbairn, Esq., M. Inst. C. E., *to* Robert Stephenson, Esq., M. Inst. C. E., &c., &c., *for the Directors of the Chester and Holyhead Railway, on the subject of a proposed Bridge across the Menai, near to Bangor. By* Eaton Hodgkinson, F.R.S.

(Continued from page 28.)

Having in the month of August last year been requested to render assistance, principally in a scientific point of view, with respect to the experiments to ascertain the practicability of erecting a Tubular Bridge across the Menai Straits, of sufficient strength for railway trains to pass through it with safety, I attended twice in London for that purpose: and as the experiments made there were on tubes of various forms of section, including several elliptical and circular ones, I investigated formulæ for reducing the strength of the leading ones. It appeared evident to me, however, that any conclusions deduced from received principles, with respect to the strength of thin tubes, could only be approximations; for these tubes usually give way by the top or compressed side becoming wrinkled, and unable to offer resistance, long before the parts subjected to tension are strained to the utmost they would bear. To ascertain how far this defect, which had not been contemplated in the theory, would affect the truth of computations on the strength of the tubes proposed to be used in the bridge,—and also to show whether the principles generally received could be applied with certainty in reasoning as to the strength of the

bridge from that of models comparatively very small,—for these two purposes I urged the necessity of a number of fundamental experiments, which, besides supplying the wants above mentioned, might enable me to obtain additional information to that from Mr. Fairbairn's experiments, with respect to the proportions that the different parts of the section of such a bridge ought to have, as well as what form it should be of, in order to bear the most.

Feeling that there might be objections against allowing me to follow the courses I proposed, however necessary it might appear to myself, I suggested a much more limited series of experiments than now appear to me to be necessary; and, as the time consumed in getting the plates rolled and the tubes prepared, caused the experiments to be delayed till the beginning of the year, the time given me has been too limited to obtain all the facts which the few experiments proposed would have afforded.

I will now give the results, so far as they have been obtained and seem worthy of reliance, subject to correction from future experiments; beginning with the reduction of Mr. Fairbairn's experiments on the strength of tubes of wrought iron made of plates riveted together.

Cylindrical Tubes.—The strength of a cylindrical tube, supported at the ends, and loaded in the middle, is expressed by the formula

$$w = \frac{\pi f}{a\, l}\,(a^4 - a'^4).$$

Where l is the distance between the supports; a, a' the external and internal radii; w the breaking weight; f the strain upon a unity of section, as a square inch, at the top and bottom of the tube, in consequence of the weight w; $\pi = 3{\cdot}14159$.

From this formula we obtain

$$f = \frac{w\, l\, a}{\pi\,(a^4 - a'^4)}.$$

As it will be convenient to know the strain f per square inch, which the metal at the top and bottom of the tube is bearing when rupture takes place, this value will be obtained from each of Mr. Fairbairn's experiments: the value w being made to include, besides the weight laid on at the time of fracture, the pressure from the weight of the tube between the supports, this last being equal to half that weight. Computing the results we have, from

$$\left.\begin{array}{lll}
\text{Experiment} & 1, & f = 33456 \\
\quad\text{"} & 2, & f = 33426 \\
\quad\text{"} & 3, & f = 35462 \\
\quad\text{"} & 4, & f = 32415 \\
\quad\text{"} & 5, & f = 30078 \\
\quad\text{"} & 6, & f = 33869 \\
\quad\text{"} & 7, & f = 22528 \\
\quad\text{"} & 8, & f = 22655 \\
\quad\text{"} & 9, & f = 25095
\end{array}\right\}\ \text{Mean } 29887 \text{ lbs.} = 13{\cdot}34 \text{ tons.}$$

Fracture in all cases took place either by the tube failing at the top, or tearing across at the rivet holes; this happened on the average, as appears from above, when the metal was strained $13\frac{1}{3}$ tons per square inch, or little more than half its full tensile strength.

Elliptical Tubes.—The value of f in an elliptical tube broken as before, (the transverse axis being vertical,) is expressed by the formula

$$f = \frac{w\, l\, a}{\pi\,(b\, a^3 - b'\, a'^3)}.$$

Where a, a' are the semitransverse external and internal diameters; b, b' the semi-conjugate external and internal diameters; and the rest as before, w including in all cases the pressure from the weight of the beam.

Computing the results from Mr. Fairbairn's experiments we have from

$$\left.\begin{array}{lll} \text{Experiment} & 20, & f = 36938 \text{ lbs.} \\ \quad\text{"} & 21, & f = 29144 \\ \quad\text{"} & 24, & f = 45185 \end{array}\right\} \text{Mean } 37089 \text{ lbs.} = 16{\cdot}55 \text{ tons.}$$

Rectangular Tubes.—If in a rectangular tube, employed as a beam, the thickness of the top and bottom be equal, and the sides are of any thickness at pleasure, then we have

$$f = \frac{3\, w\, l\, d}{2\,(b\, d^3 - b'\, d'^3)}$$

in which d, d' are the external and internal depths respectively; b, b' the external and internal breadths; and the rest as before.

Mr. Fairbairn's experiment No. 14 gives by reduction

$$f = 18495 \text{ lbs.} = 8{\cdot}2566 \text{ tons.}$$

This is, however, much below the value which some of my own experiments give, as will be seen further on.

The value of f, which represents the strain upon the top or bottom of the tube when it gives way, is the quantity per square inch which the material will bear either before it becomes crushed at the top side or torn asunder at the bottom. But it has been mentioned before, that thin sheets of iron take a corrugated form with a much less pressure than would be required to tear them asunder; and therefore the value of f, as obtained from the preceding experiments, is generally the resistance of the material to crushing, and would have been so in every instance if the plates on the bottom side (subjected to tension) had not been rendered weaker by riveting.

The experiments made by myself were directed principally to two objects:—

I.—To ascertain how far this value of f would be affected by changing the thickness of the metal, the other dimensions of the tube being the same.

II.—To obtain the strength of tubes, precisely similar to other tubes fixed on,—but proportionately less than the former in all their dimensions, as length, breadth, depth, and thickness,—in order to enable us

to reason as to strength from one size to another, with more certainty than hitherto, as mentioned before. Another object not far pursued, was to seek for the proper proportion of metal in the top and bottom of the tube. Much more is required in this direction.

In the three series of experiments made, the tubes were ***rectangular***, and the dimensions and other values are given below :—

Length.		Depth.	Breadth.	Distance between supports		Weight.		Thick-ness of Plates.	Last ob-served Deflec-tion.	Corres-ponding Weight	Break-ing Weight	Value of f, for crush-ing Strain.
ft.	in.	in.	in.	ft.	in.	cwt.	qr.	inch.	inch.	Tons.	Tons.	Tons.
31	6	24	16	30	0	44	3	·525	3·03	56·30	57·50	19·17
31	6	24	16	30	0	24	1	·272	1·53	20·30	22·75	14·47
31	6	24	16	30	0	10	1	·124	1·20	5·04	5·53	7·74
						lb.	oz.			lb.	lb.	
8	2	6	4	7	6	78	13	·132	·66	9,416	9,976	23·17
8	2	6	4	7	6	38	11	·065	·32	2,696	2,315	15·31
8	2	6	4	7	6	..		..	..	..	..	..
4	$2\frac{1}{2}$	3	2	3	9	10	12	·061	·435	2,464	2,464	24·56
4	$3\frac{1}{4}$	3	2	3	9	4	15	·03	·13	560	672	13·42

The tube placed first in each series, is intended to be proportional in every leading dimension, as distance between supports, breadth, depth, and thickness of metal,—and any variations are allowed for in the computation. Thus the three first tubes of each series are intended to be similar; and in the same manner of the other tubes, &c.

Looking at the breaking weights of the tubes varying only in thickness, we find a great falling off in the strength of the thinner ones; and the values of f show that in these—the thickness of the plates being ·525, ·272, ·124 inch—the resistance, per square inch, will be 19·17, 14·47, and 7·74 tons respectively. The breaking weights here employed, do not include the pressure from the weight of the beam.

The value of f is usually constant in questions on the strength of bodies of the same nature, and represents the tensile strength of the material, but it appears from these experiments that it is variable in tubes, and represents their power to resist crippling. It depends upon the thickness of the matter in the tubes, when the depth or diameter is the same; or upon the thickness divided by the depth when that varies. The determination of the value of f, which can only be obtained by experiment, forms the chief obstacle to obtaining a formula for the strength of tubes of every form. When f is known the rest appears to depend upon received principles, and the computation of the strength may be made as in the Application de la Mécanique of Navier, Part 1st, Article IV; or as in Papers of my own in the Memoirs of the Literary and Philosophical Society of Manchester, vols. iv and v, second series. I have, however, made for the present purpose, further investigations on this subject, but defer giving them till additional information is obtained on the different points alluded to in this report; and this may account for other omissions.

In the last table of experiments the tubes were devised to lessen or to avoid the anomalies which riveting introduces, in order to render the properties sought for more obvious. Hence, the results are somewhat higher than those which would be obtained by riveting as generally applied.

The tube 31 feet 6 inches long, 24 cwt. 1 qr. weight, and ·272 inch in thickness of plates, was broken by crushing at the top with 22·75 tons. This tube was afterwards rendered straight, and had its weak top replaced by one of a given thickness, which I had obtained from computation; and the result was, that by a small addition of metal, applied in its proper proportion to the weakest part, the tube was increased in strength from 22·75 tons to 32·53 tons; and the top and the bottom gave way together.

If it be determined to erect a bridge of tubes, I would beg to recommend that suspension chains be employed as an auxiliary, otherwise great thickness of metal would be required to produce adequate stiffness and strength.

EATON HODGKINSON.

Steam Navigation.

At the request of W. C. REDFIELD, Esq., we insert the following communication from him on the subject of Steam Navigation, being an appendix to what has already appeared in the Journal from the United States Navy Department.

COM. PUB.

APPENDIX.

Comparative weights of Shot thrown at a round, by different vessels, reckoned according to the calibre of the guns.

	Line Ship Ohio.	Frigate Brandywine.	Steam Frigate Missouri.	Light 6 gun Steamer.
	lbs.	lbs.	lbs.	lbs.
Weight thrown at broadside, . . .	1600	864	386 *	388
Do. in chase, bow on, ...	128	128	260	258
Do. " " stern on, ...	256	192	128	258
Do. by the whole armament, .			768	512

* The above is computed from the present armament of the Missouri, counting but one of her two traversing guns to act in broadside. The broadside of this vessel may, however, in favorable circumstances, be increased by shifting the guns. In the like circumstances, the whole armament of the *six-gun* steamer might be brought to bear in broadside.

	Line Ship Ohio.	Heavy Frigate.	Steam Frigate Missouri.	Light 6 gun Steamer.
Comparative powers of motion, reckoned at six miles per hour *average*, for sailing ships, through *twenty points* of the compass;—and, for the steamers, at eleven and fifteen miles, respectively, through *thirty-two points* of the compass; the results being given in comparative numbers.*	120	120	352	470
Comparative *moving powers* as given above, but reckoned as the *squares* of the above velocities, multiplied by the available points of compass in sailing.	576	576	320	7200

The aggregate weight of water necessary to be displaced by steam power, in performing one mile of distance, at common or light load, is as follows, viz :

For Steam Frigate Missouri, 76,635 tons.
For proposed six-gun Steamer, 17,801 tons, or less than ¼.

Or, for each eight-inch Paixhan gun, or its equivalent in armament, the weight of water displaced by the steam power, for each mile of distance, will be as follows:

For Steam Frigate Missouri, 6,386 tons per gun.
For proposed six-gun Steamer, 2,226 " "

Thus showing a difference of near three to 1 in favor of the light steamer, in the expense of the moving power, (per gun;) without taking into account the more favorable water-lines or angles of entrance and clearance, on which the expense in fuel, as well as the velocity, greatly depends.

The various foregoing estimates and statements may serve for illustrating the principle involved; but the writer makes no claims to absolute precision in these hastily prepared sketches. It is sufficient if the leading principles which should govern the case have been fairly brought into view.

It cannot be doubted that, in the operations of war, Time has become a most important and decisive element.

* The comparative *efficiency* of these several vessels, in general warfare, may be seen by multiplying the *weights* of shot by the available velocities of the vessel.

The following theorems are from the able Treatise of A. F. B. CREUZE, on the Theory and Practice of Naval Architecture. Prepared for the Seventh Edition of the Encyclopedia Britannica, and published in 1841 :—

Naval Architecture is at present a science of comparisons and analogies.

The resistance which the vessel will experience depends principally on the area of her cross section.

The stability of the vessel is very greatly dependent on the horizontal plane of flotation.

In war vessels, the efficiency of the armament is necessarily the primary object of the design; and the greatest effective force must be obtained at the least expense: or, the object to be obtained is *the greatest effective force with the least displacement.*

OF VELOCITY.—*Frequent opportunities for refitting and replenishing* allow of additional velocity, which may be obtained by diminished displacement.

OF LENGTH.—The displacement, the stability, and the resistance to lee-way, vary directly as the length.

OF DEPTH.—Depth is the dimension the most detrimental to the velocity.

These demonstrable propositions from the above work, (which has just fallen under my notice,) fully coincide with the views which I have maintained in the foregoing correspondence.

W. C. REDFIELD.

New York, March, 1842.

Second Annual Report of the Board of Directors of the South Carolina Rail Road Company.

GENTLEMEN,—The Board of Directors of the South Carolina Rail Road Company have now the honor to submit to the Stockholders their *Second* Annual Report on the affairs and operations of the Company for the year ending 31st December, 1845.

The gross receipts for freight, passengers and mail service, for the year 1844, were		$532,870·95
The expenditures for same period, including cost of additional machinery and interest on Two Million Debt,		392,672·31
	Nett profit,	$140,198·64
Amount of Dividends paid,		130,135·50
Balance or overplus applied to improvement of property,		$10,063·14

From which a dividend of $1·50 for the first half year, and $2·25

for the second half, making $3·75 on each share, and equivalent to 5 per cent. on the par value of the Stock, was paid, leaving as applicable to the improvement of property, $10,068·14.

The gross receipts for freight, passengers and mail service, for the

year 1845, were	$558,697·71
The expenditures for same period, including cost of additional machinery, improvement of Depots, and interest on debt, ...	389,148·10
Nett income,	$169,549·61
Amount of Dividends paid, . . .	147,900·00
Balance applied to improvement of property, .	$21,649·61

From the above two semi-annual Dividends of $2·25 and $2, equal to $4·25 on each Share, was declared, and within a fraction of 6 per cent. per annum on the par value of the Stock, leaving $21,-649·61 applicable to the improvement of the property of the Company.

In these comparative statements, it appears that the gross receipts for 1845 exceeded those of the previous year by $25,826·76; the nett income by $29,350·97, while the expenditures, notwithstanding a large outlay for the improvement of Depots, &c., were $3,524·21 less.

If from the total expenditures we deduct

1st. Interest on Foreign Debt, . . .	$109,672·62
2d. The amount applied, as shewn by Auditor, to payment of balances for construction on Columbia Branch, and for Rail Iron, improvement of Depots and arrearages of interest on Sterling Bonds, ...	25,248·00
3d. The cost as shown from Car Factory report for new extra freight and passenger cars, .	13,600·00
Amounting in the aggregate to . . .	$148,520·62

There would remain but $240,627·48 strictly chargeable to current expenses, which would be but 42 per cent. on the gross receipts. The average expenditures on the English Roads are from 40 to 45 per cent. on the receipts, which, compared with those on the American Roads, are as ten dollars to one.

Very nearly the same average between the *receipts* and *expenditures* prevails on all the Rail Roads in New England.

On the Western and Worcester Roads, considered among the best managed Roads in the United States, the receipts in 1844 were $753,-753 to $314,074 of expenditures, being 41½ per cent., and in 1845, the receipts were $810,000 to $365,000 of expenditure, being 45 per cent.

The proportional expenditures on the Georgia Road have hitherto been from 33 to 35 per cent. on the receipts; but since the extension of the Road they will probably exceed that relation this year. The

last Annual Report on the Central Rail Road presents the current annual expenses at $186,886·39 on a gross revenue of $384,000·63, or within a fraction of 49 per cent.

The number of passengers conveyed over the South Carolina Rail Road in 1845, were 56,785 against 54,146 of the previous year, while the passage money for the lesser number exceeded that for the larger, by $9,551,—which can only be explained by the facts of a less fare being charged on the through ticket for foreign travel to Montgomery, and that the increase in number of passengers has been confined to the home travel, and on short distances. The number of bales of cotton transported in 1845, was 197,657 against 186,638 in 1844, showing an excess of 11,019 bales.

The first nine months of operations for 1845, exhibit an increased receipt on the up freights of $13,548, and on the down, of $54,995. Total of excess, $68,543,—while in the last three months the up freights were $2,469·77, and the down freights $40,249·79 less. Making a total of $42,719·56 deficiency, compared with the corresponding period of 1844. This shows conclusively the unfavorable influence of the acknowledged short crop in Carolina and Georgia on the business of the Rail Road.

Had the transactions of the three last months corresponded with the nine previous months of 1845, the excess of gross revenue over the year 1844 would probably have exceeded $100,000, and without any increase of receipt the last three months of 1845 over 1844,—the total revenue of the former would have exceeded that of the latter by $70,000. These statements forcibly demonstrate the immediate dependence of the South Carolina Rail Road on the agricultural productions of this and the neighboring States—and the extent to which the business of the Road is affected by an enlarged or diminished crop.

The Reports of the Superintendent of Transportation, Mr. Hacker, and that from Mr. Darrell, Master of the Workshops, present favorable statements of the work performed at the Car Factory, and at the Foundry, Blacksmith and Finishing shops on the Locomotives, Tenders, Spark Arresters, &c. The Company now own twenty-six Locomotives, nearly all of which are in good working condition; and nineteen of the number were kept actively employed on the Road during the last season, making 1,098 arrivals and departures, and performing 342,435 miles. Three of the above Locomotives,—two of the first class, and most approved construction for passengers, and one for freight, were purchased the last season of Baldwin & Whitney of Philadelphia. During the year two Engines, the Edisto and Edgefield, have been re-built; and the Southerner, a new Locomotive, constructed entirely by the Machinist in the shops. The Orangeburg, the first Locomotive, which was built entirely by the Company's workmen, ranks very high in her class on the Road; and should the performance and endurance of the Southerner, (intended for the Inclined Plane at Aiken,) equal her predecessor, it may strongly recommend the policy of constructing, as we have hitherto repaired, all our Locomotives under the supervision of the Company's officers. This

supervision must always exercise a favorable influence on the interests of the Company, as there can be no motive, but every inducement to the contrary, either to slight work, or to be indifferent to the quality of the material used.

Mr. Lithgoe, the Superintendent, reports the Road to be in as good a condition as is "consistent with security and economy." The heavy rains at the close of the year, and the excessive cold weather, so unusual in these southern latitudes, had injured many parts of the Road, and exposed defects hitherto concealed from the most vigilant inspection. These, however, are all in progress of reparation, and the Road will soon be in a condition to sustain all the business which may offer. The experience of the last year, from the effects of an increased business, and heavier Locomotives used, shows that the Iron Rail has suffered, and the estimate of the wear by Mr. Lithgoe, is at the rate of $2\frac{1}{2}$ per cent. If this, from further observation, be found to be correct, it may be advisable to prepare in advance for the renewal of the Iron; and the Superintendent recommends that a quantity of Rails, equal to five miles of Road, be imported annually. During the last year, at the Hamburg Depots, and for additional Turnouts, there were more than two and a half miles of newly constructed Road: a portion of which was first in Trussel, and afterwards embanked. Deducting the cost of these permanent and necessary improvements, as parts of the original design, from the whole expenditure for the Road Department, it leaves for cost of maintenance of way on Hamburg Road $258 per mile, and for the Columbia Branch but $127,—which is not quite one half the amount on the Hamburg Main Trunk. This enforces powerfully the advantage and economy of adopting, *in all instances,* the heaviest Rail and the *most approved plan of construction.*

The difference in the expense of maintenance of way on one mile of Road between the Hamburg and Columbia Branches would be equal to the interest on a capital of $2000, which, if invested in the first instance on a heavier Iron, would have imparted greater durability to the structure, and involved less expense in the preservation of it. At the cost for Iron, when the Road to Hamburg was constructed, this amount would have been equal to forty tons additional weight per mile; and at the present high valuation of Iron, would pay for twenty-five tons additional per mile. In England, instead of selling, and at a sacrifice, the old Iron to replace the new, which is to be substituted, the policy of re-rolling the old at an expense of one pound sterling (£1) per ton, has been adopted. This important fact should awaken attention to the subject in this country, and continuous Roads of the extent of those projected and completed in Carolina and Georgia, (exceeding in length any others in the world,) would find it to their advantage to construct, or patronise jointly, a Rolling Mill on the immediate Line of Roads, to re-roll the Iron of their respective tracts whenever injured, or worn too thin for future use.

During the past year, the route of a Road, diverging from the Columbia Branch, at or near where it crosses the Congaree to Camden

has been reconnoitered and surveyed, and an estimate of its cost submitted; which, by adopting the heavy T Rail at the present high appreciation of Iron, will amount to $700,000,—$400,125 of the amount being for Iron. The citizens of Kershaw have fulfilled their obligations in the amount of subscription to the new Stock required by this Company; and in accordance with the agreement, and Act of the Legislature, the Road has been located between the Wateree and Camden, and most of the sections put under contract at the estimate of the Engineer. The final location between the Congaree and Wateree, a distance of from eight to ten miles, has, for the present, been suspended. Two routes have been surveyed, the one most direct to Camden, and the other crossing the Wateree, by a lower route, is made to make a circuit, lengthening the Road to Camden about $2\frac{7}{8}$ miles, and increasing the expense of construction between 40 and 50,000 dollars. The accommodation, however, which, by this direction of the Road, might be afforded to the citizens of Sumter and Clarendon, and the greater business and travel which may be thus attracted, it has been represented would more than compensate for the greater length, and enhanced cost. The Board have, therefore, suspended action on this section for a revised comparative survey and estimate, and to hear and receive further propositions from the citizens of Sumter, as to the provisions which will be made by them for this enhanced cost, so as to enable the Directors to come to conclusions, which would be in accordance with the best interests of the Company, and to favor, on equitable conditions, the largest portions of the community desiring accommodation.

The Report of the Commissioners to represent the State in the meeting of the South Carolina Rail Road Company, with the action of the Legislature on the subject of connecting the Rail Road with the wharves of Charleston, and of rendering more perfect, and less expensive, the communication with Augusta, are submitted for your consideration. To enable this Company to accomplish the latter and important object, on the expiration of the Charter of the Augusta Bridge to the present proprietors, the right or franchise to a Bridge on the Carolina side of the Savannah, is vested for fourteen years in this Company. The citizens of Georgia and South Carolina have a common and equal interest in rendering as free and as uninterrupted as practicable, the intercourse between the two States, and it is to be hoped on a better understanding of the relations between the two parties, and on which there is now an inexplicable conflict of opinion, that the points at issue may be made to harmonize with the interests of each. The section of the Act of the Legislature, which was inserted by the Committee, expressly to protect the property of the present Bridge Company, and to compel the South Carolina Company to pay an adequate compensation for the Bridge structure, when on expiration of Charter the franchise was transferred, has been most singularly misconstrued as *aggressive*, but it is confidently believed that, on a more temperate examination of the matter, it must be acknowledged that the Legislature of South Carolina acted in good

faith, and in now giving to her own citizens a franchise which she hitherto, for thirty-five years, generously surrendered, or loaned, to those of a sister State, she has not been regardless of *their claims*, or of those of the *community at large;* by making it obligatory on the Company, to which she has made the new grant, to pay a *full* and *adequate compensation* for the *Bridge structure*, and to reduce the *tolls* or *tax* upon the community, which falls in an equal degree upon Georgians, as Carolinians, *to one half the present rate.*

Your Board of Directors, with much satisfaction, report, as in confirmation of the foresight and wisdom of the policy assumed at an early period on their part, the promptness and fidelity with which the Georgia, and the West Point, and Montgomery Rail Roads, have fulfilled their obligations on the guarantees given by this Company. Early in September last, the Georgia Company completed their Road to its Terminus at Atlanta, 172 miles from Augusta, where, uniting with the Western and Atlantic Rail Road, this has since been extended to the Oothcaloga station, 80 miles beyond. These enterprises have already penetrated the interior of Georgia 252 miles from Augusta, and 388 miles from Charleston, in the direction to that inexhaustible granary of the West, the Valley of the Mississippi. The influence of these Rail Roads has already been favorably felt on the trade and travel of that distant section of country, which hitherto, from its interior position, had no vent for its surplus productions; or which, by the natural channels, at the uncertain seasons of flood, had to seek, by a circuitous route, the more remote markets of Orleans and Mobile. The near approach of the Western and Atlantic Road to Rome, on the Coosa, has induced the enterprise of a Steamer on that river, which, plying between the head of the Shoals of the Ten Islands and Rome, a distance of 180 miles, is already beginning to divert the Coosa Valley trade, which formerly found its market in Mobile, up stream, towards the Atlantic ports. The citizens of East Tennessee, and of North Alabama, have likewise, by the approximation of these facilities of new intercommunications, been attracted in this direction, and already has Western produce, this season, found a ready and profitable market in Augusta and Charleston, which formerly remained to decay in their barns at home, or had to seek, with all the delays, expenses and hazards of a river and circuitous navigation, the distant and ever uncertain and fluctuating market of New Orleans.

The West Point and Montgomery Rail Road, assisted by the State of Alabama, and by the guarantees afforded by the Georgia and the South Carolina Rail Road Companies, has succeeded in placing the old part of their Road in such an improved condition as to enable it to run, with security and despatch, daily freight and passenger trains from Cheraw to Montgomery, and at hours to correspond with the schedule on the Georgia and Carolina Roads. The Company is now actively engaged in extending that Road to its Eastern Terminus on the Chattahoochie, and which will reduce the stage route to Atlanta to 85 miles.

The success of these Atlantic enterprises has at last awakened a corresponding spirit in the States bordering on the Mississippi. At a convention held at Memphis in November last, among the representatives from the State of South Carolina, were three of the members of your Board of Directors, and with great satisfaction they report that the action of that Convention was enthusiastic in favor of Rail-ways, seeking a connexion with those terminating in the *South Atlantic Sea Ports;* and already have the results of these proceedings begun to be developed. A Charter has been obtained from the Legislature of Tennessee, and a Company organized, at the head of which has deservedly been placed the intelligent and enthusiastic Dr. J. Overton, having for its object the construction of a Rail Road from Nashville on the Cumberland to Chatanouga on the Tennessee; there to unite with the Western and Atlantic Rail Road, the termini of which, via Augusta and Macon, are at Charleston and Savannah. This Road, in an opposite direction, points to future connexions with the States bordering on the upper Mississippi and Missouri, and in the progress of North-Western emigration, may, in time, unite with, and stimulate the enterprise of Whitney, which looks to a terminus on the Columbia river in Oregon. *In the middle section of the Mississippi Valley*, the interests of Memphis, of North Alabama, and of the Coosa Valley, have all awakened to a Road to connect with the Western and Atlantic, at Kingston near Rome. In pursuance of this project, a Road from Memphis to La Grange, 50 miles in length, has all been graded, and is now prepared for the superstructure. An intermediate link, in the chain from Tuscumbia to Decatur in Alabama, of 42 miles, is finished, and in daily operation, and for the construction of a third link from the Double Springs, below Rome, in the Coosa Valley, by the Sand mountain, to Gunter's Landing on the Tennessee, 38 miles in extent, a Company is about to be organized. which will be entitled to receive, in aid of the enterprise from Alabama, one half of the 2 per cent. fund, amounting to 160,000 dollars.

In a more Southern direction, the citizens of Vicksburg, Grand Gulf, and Natchez, have all turned their attention to unite on some common trunk of Rail Road, which, passing Eastwardly through Middle Alabama, will seek a union with the West Point and Montgomery Rail Road at Montgomery. A favorable Charter, in aid of this project, has already been obtained from the States of Alabama and Mississippi, and the latter State, in aid of its execution, has contributed the 2 per cent. fund, now amounting to 300,000 dollars. From Vicksburg, there is an excellent Rail Road to Jackson, 50 miles in length, already finished, and which will soon be extended some 14 or 15 miles beyond, to Brandon. On this route, therefore, but 230 miles of Road remains to be constructed, to afford a continuous line of Rail-way from West Point on the Chattahoochie, to the Mississippi river; and 85 miles of additional Road make the route continuous from Charleston and Savannah. In connexion with these Atlantic Rail Road communications with Vicksburg, Grand Gulf, and Natchez, crossing the Mississippi at one or all of these points, Roads

are already projected, looking further to the West, which, uniting *on a common trunk,* in the rapid progress of South-Western expansion, and emigration, will, in time, be made to course either through the new acquired territory of Texas, and by the Mexican provinces to a terminus at Mazatlan, in the Bay of California; or, taking a more Northern direction by the Valley of the Red and Arkansas rivers, may easily pass by the Southern Gorges in the Stony Mountains, and find, in the course of events, *certain* though *slow,* a more favored location in the imposing Bay of San Francisco, on the Pacific.

In a *more Southern quarter,* the success of the Carolina, Georgia and Alabama enterprises, has revived the old project of a Rail Road from Montgomery to Pensacola, Blakely and Mobile, to connect by Steam-boats from thence with the Grand Gulf Rail Road from New Orleans to a point on Lake Borgne, in the rear of Cat Island, 40 miles of which is now completed, and in daily operation. All these enterprises cannot but stimulate the citizens of the different sections of country through which they are to course; and seeking, as they all do, a connexion with those which terminate in our South Atlantic Ports, it should to us be a subject of congratulation, and on which there should be the most harmonious co-operation by all interests. Let Carolina and Georgia be checkered by Rail-ways—let these all unite with those which, to the same extent, are intended to intersect the Great Valley of the Mississippi, and even in the progress of time, *extend to the Pacific.* Let our enterprising Western brethren be afforded the facilities of communicating, *at all times,* with our Southern Atlantic Sea Ports, by routes *shorter, cheaper,* and more *expeditious,* and to markets more *regular* and *certain* in remunerating prices, than those they are now in the habit of frequenting; and Charleston and Savannah, without, under a mistaken feeling of rivalry, struggling for a monopoly, *which neither can attain,* will find their true policy in the harmony of a *free and unrestricted trade,* which imparts to each section of country what naturally belongs to it, and sustains, throughout the whole community, the invigorations of an animated and healthy circulation.

All of which is respectfully submitted by

James Gadsden, President.

Charleston, S. C., Feb. 10, 1846.

No. 3.

Statement of the number of Passengers conveyed upon the Rail Road between Charleston, Hamburg and Columbia, with the amount received for Freight and Passage, from 1st January 1845, to 1st January 1846.

	PASSAGE.						FREIGHT.			
	UP.		DOWN.		UP AND DOWN.		UP.	DOWN.	UP AND DOWN	TOTAL AM'T.
	No. Pass.	Amount Pass.	No. Pass.	Amount Pass.	No. Pass.	Amount Pass.	Amount Freight.	Amount Freight.	Amount Freight.	Freight & Passage.
January,	1,898	6,749 94	1,854	6,039 85	3,752	12,789 79	9,588 76	14,265 10	23,853 86	36,643 65
February,	1,838	6,129 20	1,672	6,417 22	3,510	12,546 42	10,983 74	29,418 84	40,402 58	52,949 00
March,	2,855	9,292 17	1,995	6,993 87	4,850	16,286 04	19,454 56	26,284 08	45,738 64	62,024 68
April,	7,858	9,325 94	7,293	8,614 97	15,151	17,940 91	15,819 60	19,476 96	35,296 56	53,237 47
May,	2,142	7,835 14	1,872	6,293 93	4,014	14,129 07	10,004 17	10,285 02	20,289 19	34,418 26
June,	1,843	5,943 18	1,468	4,787 11	3,311	10,730 29	7,628 47	7,890 19	15,518 66	26,248 95
July,	1,583	5,315 80	1,452	4,680 24	3,035	9,996 04	8 322 11	8,435 49	16,757 60	26,753 64
August,	1,313	4,337 01	1,251	3,787 87	2,564	8,124 88	11,784 42	3,876 06	15,660 48	23,785 36
September,	1,649	6,055 64	1,277	4,388 99	2,926	10,444 63	25,457 09	7,119 39	32,576 48	43,021 11
October,	2,433	9,922 36	1,978	7,631 86	4,411	17,554 22	24,709 14	13,859 74	38,568 88	56,123 10
November,	2,386	8,853 54	1,901	7,423 28	4,287	16,276 82	14,741 49	12,970 34	27,711 83	43,988 65
December,	2,793	8,156 64	2,181	6,991 34	4,974	15,147 98	9,981 55	8,632 50	18,614 05	33,762 03
Total,	30,591	87,916 56	26,194	74,050 53	56,785	161,967 09	168,475 10	162,513 71	330,988 81	492,955 90

RECEIVED for Freight and Passage as above,	$ 492,955 90
" Tickets from Hamburg to Charleston, sold by the Geo. R. R. Co., from Jan. 1, 1845, to Jan. 1, 1846,	8,895 92
" Iron transported for the Georgia Rail Road Company, from Jan. 1, 1845, to Jan 1, 1846,	11,327 90
TOTAL for Freight and Passage.	$ 513,179 62
" Transportation of the Mails for the past year,	40,254 94
" Rents, Storage, Oak-wood sold, &c., for past year,	5,263 15
" Capital Stock,	620 00
" Sales of Aiken Hotel,	2,978 39
	$ 562,296 10

			Arrivals.	Departures.	Average No. Eng. Run'g.	Miles Run.
1845.	1st	Half	575	564	19	177,402
"	2d	"	523	523	20	165,033
			1,098	1,087	19	342,435

No. 4.

Statement of the number of Bales of Cotton received in Charleston by the Rail Road, from 1st January, 1845, to 1st January, 1846.

	Hamburg.	Aiken.	P'kville.	Midway.	Br'chville.	Columbia.	Gadsden.	Lewisville.	Orangeb'g.	Way H. B.	Way C.B.	Total.
January,	6,756	88	545	246	80	7,099	536	178	26	153	438	16,145
February,	15,777	157	630	227	180	18,537	962	374	200	220	585	37,849
March,	17,164	141	317	129	61	14,985	533	562	64	89	170	34,215
April,	16,053	88	250	127	90	8,713	433	173	297	61	8	26,323
May,	9,428	10	49	78	82	3,066	27	32	27	10	30	12,727
June,	7,715	8	72	2	0	1,806	146	1	28	0	282	10,142
July,	7,757	49	10	14	8	1,321	23	38	0	0	15	9,235
August,	2,298	0	13	14	2	664	362	24	0	8	1	3,386
September,	3,653	5	51	151	80	2,529	231	150	21	33	243	7,147
October,	7,396	107	353	351	105	4,362	955	820	111	73	973	15,606
November,	8,129	77	439	226	71	4,112	640	276	143	107	582	11,802
December,	5,202	53	351	199	43	2,585	596	321	94	126	510	11,080
Total,	107,328	783	3,080	1,764	802	69,779	5,444	2,949	1,011	880	3,837	197,657

Statement of the number of Packages and Pieces forwarded upon the Rail Road from 1st January, 1845, to 1st January, 1846.

In January,	3,884	Pieces and	Packages from	25	Vessels.
February,	3,323	do.	do.	13	"
March,	3,740	do.	do.	27	"
April,	5,036	do.	do.	27	"
May,	2,371	do.	do.	28	"
June,	2,504	do.	do.	25	"
July,	4,125	do.	do.	31	"
August,	6,837	do.	do.	26	"
September,	15,010	do.	do.	33	"
October,	16,957	do.	do.	46	"
November,	7,107	do.	do.	41	"
December,	2,773	do.	do.	39	"
	73,667			361	

Statement of articles received by the Rail Road, and forwarded to other places, from 1st January, 1845, to 1st January, 1846.

6,974	Bales	Cotton,		111	Boxes	Mdze,
776	"	Yarn,		5	Casks	"
12	"	Rags,		24	Bbls,	"
1	"	Goods,		3	Kegs,	"
21	"	Roots,		4	Bags,	"
8	"	Wool,		6	Trunks,	"
36	Bags	Roots,		2	Bundles,	"
479	"	Feathers,		1	"	Scythes,
3	"	Furs,		12	"	Leather,
3	"	Wax,		3	Boxes	Rifles,
2	Tierc.	Wax,		3	"	Indigo,
2	"	Copper,		1	"	Copper,
1	"	Mdze,				
3	Hhds.	"		8498	Packages.	

No. 5.

Statement of the Receipts and Expenditures for the year 1845.

Gross Receipts from Freight, Passage and the Mails, from the 1st January to 30th June, 1845,	298,801 31	
Ordinary Current Expenses, for same time, . . .	194,867 55	
Nett Profit for the first half year,		103,933 76
The same, from 1st July to 31st December, 1845, . .	259,896 40	
Ordinary Current Expenses for same time, . . .	194,280 55	
Nett Profit for the second half year,		65.615 85
Nett Profit for the year 1845, ...		169,549 61
From this Nett Profit two Dividends have been paid, . . .		147.900 00
Leaving a balance applied to the improvement of property of		$21,649 61
In addition to this, the Company has increased its indebtedness		31,814 30
And received from sales of Aiken Hotel and from Stock		3.598 39
Making the amount applied to other purposes, not deemed Ordinary Current Expenses,		$57.062 30
And accounted for as follows:		
Improvement of Depots and other property, including 3 new Locomotives,	32,920 70	
Payment of old Claims on account of the construction of Columbia Branch,	13,934 09	
Purchase of 2 Negroes and Land, ...	1,050 00	
Purchase of Rail Iron, ...	2,426 31	
Payment of arrears of Interest on Sterling Bonds.	6,722 20	57.062 30

Gross Receipts from Freight, Passage and the Mails, &c., for the year 1845,	$ 558,697 71
From sales of Aiken Hotel and Stock, ...	3,598 39
	562,296 10
" Increase of indebtedness, ...	31,814 30
Total Receipts,	594,110 40
Paid Ordinary Current Expenses for the year,	389,148 10
	204,962 30
" Two Dividends, ...	147,900 00
Leaving a balance (accounted for as above) of	57,062 30
Deduct the balance of Indebtedness, ...	31,814 30
Balance of receipts, after paying Ordinary Current Expenses and two Dividends,	$25,248 00

Regular income from the Road for the year, . . .		$ 558,697 71
" Ordinary Current Expenses, . .	389,148 10	537,048 10
Amount of two Dividends,	147,900 00	
Nett Balance of the Regular Income from the Road,		21,649 61

[Interest on Sterling Bonds for the year, $109.672 67.]

AMERICAN PATENTS.

List of American Patents which issued in the month of August, 1845. With Remarks and Exemplifications, by CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an improved method of making *Matrices for Casting Printers' Types;* Thos. W. Starr, Philadelphia, Pa., August 4.

This is for forming matrices on types by the electrotype process, which afterwards are properly fitted up to give the necessary strength and durability.

Claim.—"Having thus fully described my method of forming matrices for casting the face of printers' type, and other articles therein, what I claim as new, and desire to secure by letters patent, is the manner of forming the same by means of a common type or cut, and a metallic plate with an opening, with slanting sides, the two arranged and prepared in the manner described, and placed in a solution of sulphate of copper, and connected with the pole of a galvanic battery, in the same manner usually practised in electrotyping; and after receiving a sufficient deposit of copper, to be fitted up for use, in the manner set forth."

2. For an improvement in *Artificial Nipples;* Elijah Pratt, New York city, N. Y., August 4.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of a valve with artificial nipples, as described."

The artificial nipple is made in the usual manner, to fit over the breast, and the aperture for the flow of milk is covered over with india rubber perforated to act as a valve.

3. For making *Keyed and other Bugles of Tortoise or Turtle Shell;* George W. Shaw, Thompson, Connecticut, August 4.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner or method of cementing or welding tortoise or turtle shell in the shape or form of keyed bugles, by winding with cord or twine, and steaming it, and making keyed bugles from that article, as before described."

4. For improvements in the *Hot-Air Furnace;* Gardner Chilson, Boston, Massachusetts, August 4.

Claim.—"Having thus described my improvements in hot-air furnaces, I shall state my claims as follows:—

I do not claim simply making the top of the fire chamber domeformed, nor do I claim the combination of an outer and inner hot-air

chamber; but what I do claim as my invention, is connecting the cylinder of the fire chamber with the central hot-air chamber, by means of a dome-formed top, and discharging the hot air through the middle thereof, whereby the air of the inner and outer chambers is more effectually brought into contact with heated surfaces than in any other arrangement heretofore known.

I also claim making the cast-iron top plate of the ash pit, with cells filled with non-conducting substances, for the bottom of the fire-pot to rest on, and thus prevent the said plate beyond these cells, where it forms the bottom of the air chamber or chambers which surround the fire-pot, from being cracked by the heat, which would otherwise be conducted from the fire-pot to this plate, as described."

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5. For an improvement in the *Uterine Supporter;* Ephraim Colvin, North Granville, New York, August 4.

Claim.—"Having thus fully described the manner in which I construct my abdominal supporter, for the cure or relief of *prolapsus uteri*, what I claim therein as new, and desire to secure by letters patent, is the combining with the hypogastric or abdominal pad a spring lever, such as is shown at B B, in the accompanying drawing, in such manner as that it may be used to increase or diminish the pressure on the lower part of said pad, by an arrangement substantially the same with that herein fully made known."

The lever indicated in the claim by the letter B B, is attached by one end to the upper part of the foundation plate of the pad, and extends down nearly to the lower edge, and its under face has a spring catch, which takes into notches on the face of the plate to separate the lower end of the plate from the spring, which forces the pad inwards to increase its pressure.

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6. For an improvement in *Watches, Chronometers, &c.;* John Bliss and Frederick Creighton, New York, August 4.

Claim.—"We do not claim to have invented any of the parts herein described, as all are already in use, and well known; neither in our arrangements, as above described, do we claim to have obtained any results not contemplated or sought for by others, our claim being only for obtaining an increase of equality in the performance of watches, chronometers, and other timepieces, first, by the mode we have described and shown of forming the balance rim with quarter circles, arches, or segments, each way from each end of the arm, instead of a half circle from each end in opposite directions; and, secondly, by the application of a second balance spring above, below, or inside the single balance spring heretofore in use, substantially as the same are described."

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7. For an improvement in *Harness, Collar and Hames;* F. C. Curtis, Columbia, South Carolina, August 4.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is the combination of a bow of wood, to fit the neck of a horse or mule, with the mode herein described of ironing and padding the same, so as to constitute the harness, collar and hames, all complete in one."

To a wooden bow properly formed and padded, (except one face,) are attached the draft rings, trace hooks, and in short all the parts usually belonging to the hames; and the upper ends of this bow, extending above the horses' neck, are connected together by a strap which, when loosened, and the chafe leather removed, permits the bow to open sufficiently to be removed from the horses' neck.

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8. For improvements in the *Stove;* Jehiel F. Farrand, Port Byran, New York, August 4.

Claim.—"Your petitioner further represents, that he claims as his invention, and desires to secure by letters patent, the following particulars and combinations :—

1st. An elliptical covering in combination with the circular oven, allowing the heat to act with more uniformity on all parts of the oven, and affording the draught an opportunity to unite and pass off freely.

2d. The manner in which I have combined and arranged the valves and with respect to the draught pipe and boiler holes, and, in combination therewith, the two division plates extending back on each side of the valves in the centre of the stove."

The elliptical covering is the casing which surrounds a cylindrical oven, the longitudinal axis of the ellipse being vertical, so that the space between the oven and casing which constitutes the flue is less on the sides than at bottom, where it communicates with the pipes from the fire, and at top, where it connects with the chimney. The arrangement of the dampers could not be made clear without drawings.

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9. For an improvement in *Nursing Bottles:* Elijah Pratt, New York city, N. Y., August 9.

Claim.—"What I claim, and desire to secure by letters patent, is the contractile valves to sucking and air-tubes of nursing bottles; and also the application of artificial nipples to the same, as herein set forth."

The cork of the nursing bottle is provided with an air-tube to supply air, and another tube with an india rubber valve, which is then covered with the nipple.

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10. For an improved method of *Lessening Friction in Clocks, &c.;* Eli Terry, Plymouth, Connecticut, August 9.

Claim.—"Having thus fully described the nature of my improvement in clocks or timepieces, and shown the manner in which my friction-preventer operates, what I claim therein as new, and desire to secure by letters patent, is the employment of a suspension piece,

arranged and operating substantially in the manner of that which I have denominated the friction-preventer, for sustaining the weight of the balance wheel and its arbor, as herein fully made known."

The arbor of the balance wheel is supported by a stirrup which vibrates as the balance rotates, so as to relieve the journals or pivots from the friction due to the weight of the balance.

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11. For an improvement in *Furnaces for Heating Buildings, &c.;* Adrian Janes, New York city, N. Y., August 9.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the obtaining of additional heating surface, and causing a lengthened circulation to the flame, smoke and heat within an enclosure of metal or walls of a hot-air furnace, without any downward draught, by the means of a system of tubes, combined, arranged and situated as above described."

The furnace or fire chamber communicates with the chimney by means of a series of tubes, bent in the form of a horse-shoe, placed one above the other, and with sufficient space between each for the circulation of air—the whole being surrounded by masonry, to form a chamber for heating air.

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12. For an improvement in the *Gas Burner;* William Blake, Boston, Massachusetts, August 9.

Claim.—"I shall therefore claim the combining with the space directly beneath the orifices of discharge of the gas, and with the supply or branch tubes, an expansive chamber, so as to operate in the manner and for the purpose herein before set forth.

I also claim making the lower part of the inner cases of the burner with a bell-shaped opening or mouth, in the manner and for the purpose as above specified."

The object of the chamber is to permit the gas to expand, and thus to keep a regular supply at the discharge orifices; and the object of making the lower part of the case of the burner bell-mouthed, is to make the area at the bottom greater than at the top, where the combustion takes place.

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13. For an improvement in *Saddles;* Benjamin Suits, Chittinango, New York, August 9.

Claim.—"Having thus fully described my machine, what I claim as new, and desire to secure by letters patent, is constructing the cover of the saddle in such a way as to allow the tree to be stuffed, or covered with stuffing, by making said cover in one piece, so as not to present the projection of jockeys, or small skirts, or the ridges occasioned by draw-downs, &c."

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14. For an improvement in the *Manufacture of Test Paper;* Arthur Varnham, London, England, August 9.

This is for making test paper to detect any attempt which may be made to extract characters from the surface by making the sheet of three thin films, the inner one different from the outer ones, the test sheet within possessing chemical qualities different from the outside sheets, so that any attempt to extract the ink by chemical agents, which would leave no trace on the surface, will act on the test sheet within.

Claim.—" What I claim as my invention is the above described improvement, or manufacture, or combination of a colored sheet of test paper and one or more plain white, or lighter, or darker, or different colored sheets or surfaces of paper, applied to one or both sides of the test sheet, substantially as above specified."

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15. For an improvement in the apparatus for *Impregnating Meats, &c., with Brine;* Dion. Lardner and James Davidson, New York city, N. Y., August 9.

Claim.—"What we claim, therefore, as our invention, and desire to secure by letters patent, is the manner herein described, in which we have arranged and combined the respective parts of the apparatus for salting or impregnating provisions with any desired solution, as set forth; that is to say, we claim the combining of a common lifting pump, and of a force pump, with the vessel and with the cistern, substantially in the manner and for the purpose herein fully made known."

The provisions to be impregnated are placed in the vessel, the brine is then introduced from the cistern above through the bottom, which expels the air through a valve at the top; the cock which admits the brine at the bottom is then closed, and the brine pumped out of the vessel F by the suction pump; thus leaving the provisions in a vacuum, the brine is then again admitted. The force pump is used at first to expel the air by forcing in the brine, but this is not required afterwards.

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16. For an improvement in the *Reflecting Baker;* William Taintor and Harlow S. Orton, Porter county, Indiana, August 9.

Claim.—" What we claim is constructing a reflecting baker, in the form described; that is to say, the baker of cylindrical form, having the grate or shelf upon which the articles are to be cooked placed in the centre, in the manner described."

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17. For improvements in the machine for *Hulling and Cleaning Clover Seeds, &c.;* Samuel W. Powell, Turbet, Pennsylvania, August 16.

Claim.—" Having thus fully described my machine for hulling and cleaning clover seed, what I claim as new, and desire to secure by letters patent, is, first, the grooved form of the projections upon the beating cylinder and surrounding concave, the grooves being either circular or spiral.

I also claim the manner in which the beating and perforated concaves are connected by the double apertures, and, in combination therewith, the form of the discharge aperture for the chaff; all combined, arranged, and operating substantially as herein set forth—not confining myself to the exact forms and proportions herein represented, but the general principles of the machine."

Without drawings we could not give a clearer description of this arrangement than the claim furnishes, without going beyond the limits of this work.

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18. For an improvement in the machine for *Cutting Laths;* Solomon F. Finch and James Wheeler, Rootstown, Ohio, August 16.

Claim.—" We are aware that machines for cutting laths have been made with a carriage to carry the bolt or block against the edge of a knife, and that the bolt or block has been griped preparatory to and during the operation of cutting, in machines in which the knife is carried against the bolt, instead of the bolt against the knife, and the bolt liberated before the knife has been moved back clear of the bolt; and hence we wish it to be clearly understood that we do not claim to be the original and first inventors of these; but what we do claim as our invention, and desire to secure by letters patent, is making the carriage which carries the bolt or block to the knife in two parts, moving on each other, and connected together by a spring, or analogous device, so that the bolt is griped whilst being carried against the edge of the knife, and still griped until drawn back of the edge of the knife, and then liberated, for the purpose and in the manner substantially as herein described."

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19. For improvements in the machine for *Cutting Shoe Pegs;* T. A. Robertson, Georgetown, D. C., August 16.

The patentee says:—"The nature of my invention consists in adding to the knife which splits off the rows of pegs small knives set in front of the large one, and at right angles thereto, at the distance of a single peg apart, so that as the row of pegs are split off, each individual peg shall be separated from the rest, thus perfecting the whole at one operation."

Claim.—" What I claim is the combination of the knife (the long knife) with the short knives placed at right angles thereto, for splitting the pegs both ways—the whole being combined with the fluted roller as before specified."

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20. For improvements in the *Mill for Grinding Bark, Coffee, &c.;* Beriah Swift, Washington, New York, August 16.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is making the grinding teeth of mills in concentric rows, projecting from the surface of the plates, so that the teeth of one plate shall run in the spaces between the teeth on the other, and vice versa, in combination with the grooves or furrows running towards the peri-

phery of the plates, through which the substances acted upon are carried outwards, whether these furrows be arranged radially, according to what is technically termed the eight-quarter dress, or in any other manner, leading from the inner to the outer range of teeth.

And I also claim, in combination with the teeth, arranged as expressed in the above claim, the breaking teeth on a cylinder or cone, arranged substantially as herein described and for the purpose specified."

The teeth covered by the first section of the claim are arranged on disks, and at the centre of the runner there is a cone or cylinder with large teeth, for breaking the substance to be ground by the teeth on the disk; this breaking part is covered by the second section of the claim.

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21. For an improvement in *Flexible Hose Pipes;* Horace H. Day, Jersey City, N. J., August 16.

This is for combining a tube woven of some fibrous substance with an inner tube made of india rubber.

Claim.—" What I claim is the combination of the external textile tube with the entire india rubber tube, as described."

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22. For improvements in *Door Locks;* Angus McKinnon, New York city, N. Y., August 16.

Claim.—" Having thus fully described the manner in which I construct my lock, and explained the operation of the respective parts thereof, I do hereby declare that I do not claim to be the inventor of a key with an expanding bit drawn out by an eccentric, this having been before used ; nor do I claim the employment of a series of tumblers or levers, which are to be raised to different heights by the key bit, these being also well known ; but what I do claim as constituting my invention, and desire to secure by letters patent, is the particular manner in which I have combined and arranged certain parts of my lock, by which combination and arrangement a new and useful effect is produced ; that is to say, I claim the manner in which I have combined the key, having an expanding bit, with the revolving box or drum, the latter being equal in thickness to the bit of the key, and having a key-hole through it by which it is turned with the key, in the manner and for the purpose set forth.

I claim the manner in which I have combined what I denominate the pressure tumbler, carrying the stump with the ordinary tumblers; the pressure tumbler having its fulcrum pin on the lock bolt, and the ordinary tumblers their fulcrum pin attached to the box of the lock, and also having their fore-ends provided with projecting teeth, for the stump to act upon, in the manner and under the conditions set forth ; the whole arrangement and operation being substantially the same with those herein described."

The bit of the key is composed of two parts, one sliding on the other, so that when the key is turned a cam acts on the movable part

and forces it out to act on the bolt and tumblers; the key when contracted is received in a key-hole in a revolving box or cylinder, and when the two are turned together at the proper time, the movable part of the bit is forced beyond the periphery of the cylinder. There is a tumbler that turns on a pin projecting from the tumbler, and from this tumbler projects a stump which, when the bolt is forced out, takes into teeth on the other tumblers, to prevent them from being lifted up.

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23. For improvements in the *Cooking Stove;* Hosea Huntley, Rochester, New York, August 16.

Claim.—"Having thus fully described the nature of my improvements, in the manner of constructing cooking stoves, what I claim as new therein, and desire to secure by letters patent, is, first, the manner in which I arrange and combine my dampers, so as to close the opening for the admission of heated air to the cavity in the oven door, and to be opened by the closing of said door, as set forth.

Secondly, I claim the manner of arranging and combining the semi-cylindrical dampers with the flue spaces of the stove, for the purpose and substantially in the manner herein made known."

The door of the oven is double, with a flue space within, and the door frame, which is also a flue space, is provided with a damper, which closes by gravity when the door is opened. The flue space just below the pipe is provided with two semi-circular dampers jointed together, so that either side can be opened independent of the others.

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24. For an improvement in the *Washing Machine;* Harvey W. Sabine, Rushville, New York, August 16.

In this machine the clothes are washed by the action of a pounder or piston that presses them against the end of a square box or tub, and to increase the force with which the pounder strikes the clothes the handle has a slot in it with a roller that acts on an inclined plane; the angle formed by the handle and the inclined plane gradually increasing towards the end of the stroke, which increases the force.

Claim.—"Having thus fully described my improvement, what I claim as my invention, and desire to secure by letters patent, is the combination of the inclined plane with the washer or piston, constructed and arranged in the manner and for the purpose set forth."

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25. For an improvement in the *Lard Lamp;* Andrew Keyser, Fulton, Maryland, August 20.

Claim.—"Having thus fully described the nature of my improvement in the lamp for burning lard and other fatty substances, what I claim therein as new, and desire to secure by letters patent, is the employment of a wick receiver, which is attached to the lower end of the wick tube or tubes, for the purpose of containing a length of

wick that may be coiled up therein, in the manner and with the intention herein made known."

The wick holder above referred to is a small perforated metal box, which contains the surplus portions of the wick to which the oil or lard is admitted from the reservoir through the perforations.

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26. For an improvement in the *Hammer;* Solomon Anderson, Garrettsville, New York, August 20.

The "nature of this invention consists in extending the claw of the hammer, in a circular form, round to the hammer handle; the opening of the claw continues to within an inch of the handle, where it unites and forms a loop, or second eye."

Claim.—"What I claim is the connecting of the claw to the handle as above described, with the loop at the end for the handle to pass through."

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27. For an improvement in the *Pivot Chair;* Jordan L. Mott, New York city, N. Y., August 20.

Claim.—"Having thus fully described the nature of my improvement in the eccentric revolving pivot chair, what I claim as new is the placing of the pivot or pin upon which the seat revolves at an equal distance from the two sides of the seat, and at two-fifths (or nearly so) of that distance from the back of the chair, as set forth, or at a point so near to that distance as shall be substantially the same in the result of its action."

Pivot chairs have heretofore been made with the pivot in the centre of the seat, which renders them unsteady, particularly when the pedestal is small, and as this is principally for cast metal chairs the patentee renders it more stable and permanent by placing the pivot two-thirds of the depth of the seat from the back. This is particularly adapted to the present mode of dressing, which throws the person farther forward.

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28. For an improved process of *Clarifying Salt Water preparatory to making Salt;* Nehemiah P. Stanton, Syracuse, New York, August 20.

Claim.—"What I claim as my invention, discovery, art, or improvement, and desire to secure by letters patent, is the art or process of separating the impurities contained in salt water or brine, in its crude state, by adding a sufficient quantity of common salt to the salt water taken from the salt springs, wells, or other sources, in its crude state; when properly mixed and dissolved, to bring the brine in the vats or cisterns to immediate saturation, for the express purpose of precipitating the impurities and depositing them in the bottom of the vats or cisterns, without the aid of evaporation or of solar or artificial heat. I do not claim adding salt to salt water, for the purpose of concentrating, as is frequently done; but I do claim the process,

above described, of separating the impurities from salt water by the addition of salt thereto, allowing the impurities sufficient time to settle, and the drawing off for evaporation."

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29. For an improvement in the *Horse Power;* James Leffel, Springfield, Ohio, August 20.

Claim.—"Having thus fully described the characteristics of my invention, and the manner of making and using the same, I wish it to be distinctly understood that I do not make claim to the employment of a series of wheels having the same axis of motion when the sections of the shafts are separated from each other by a permanent sleeve, when the arrangement of the wheels is such as to cause the sections of the shaft to turn in reverse directions, as these are well known and do not attain the end contemplated by me, and pointed out above; nor do I claim simply oiling a journal through a perforation in the shaft, as this has long since been known; but what I do claim as my invention, and desire to secure by letters patent, is the arrangement of two sets of cog or belt wheels, and pinions connected therewith, each set consisting of not less than two wheels, with their appropriate pinions, on two shafts made in sections turning on each other, and in the same direction, for the purpose of avoiding friction, and rendering the machinery compact, as herein described.

And I also claim, in combination with the arrangement of shafts herein described, the oil passages, whereby the oil applied at two places is conducted to all the rubbing surfaces of the series of shafts and bearings, as herein described."

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30. For an improvement in the *Cooking Stove;* Francis S. Low and John S. Leake, Albany, New York, August 20.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the construction of a diving or descending flue at the end of the fire-box, communicating with the flue beneath an oven, placed immediately behind and upon a level with the fire-box, or nearly so."

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31. For an improved *Tool for turning Grindstones used for grinding the dies used in Nail machines;* Charles Arthur, Keeseville, New York, August 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of an elastic metal tool for cutting and turning off, and shaping the periphery or sides of grindstones, as above described, in any form or manner substantially as herein described, in which an elastic metal tool may be applied to that use."

---

32. For a composition of matter for *removing Acids from Cloth, &c.;* Solomon Guess, Boston, Massachusetts, August 26.

Claim.—"I claim the afore-specified combination of ingredients,

whether in the proportions set forth, or in any other which may, under any circumstances, be found better applicable for the purpose intended."

This compound consists of four pounds of fucus vesiculosus (sea or bladder wrack) boiled in three pints of water until reduced to one, mixed with one quart ox gall, one pound of carbonate of ammonia, three quarters of a pound of alum, and twenty-four pounds of common white soap; the whole is properly melted and mixed together.

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33. For an improvement in the *Washing Machine;* T. C. Benteen and H. W. Zimmerman, Petersburg, Virginia, August 26.

Claim.—"What we claim is the manner in which we construct the wash board, so as to effect a partial vacuum within its lower portion by centrifugal action, in the manner and for the purpose above described."

The wash frame moves up and down in a box by a lever, and on each side there is hinged to the box a wing which, as the wash frame is lifted, is moved out by projections on the wash frame; this produces a partial vacuum by which the parts are forced back, and by this means the clothes placed between the wash frame and wings are washed.

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34. For an improvement in *Lasting Boots;* David Harrington, German Flats, New York, August 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the apparatus for the lasting boots by the compound instep and shank draught, as herein above substantially described and set forth, by means of the above described machine, or any other substantially the same."

This is for stretching the instep part of boots made of lasting. The inner sole is placed on the last and the cloth carried around the instep; an apparatus is then applied which consists of two legs that rest on the sole, connected at top with a cross piece, in which swivels a screw that passes through a nut, to which are jointed two clamps that gripe the edges of the cloth, so that by turning the screw the cloth is stretched on the last, and then by means of another screw that unites the two clamps, they are drawn together, which laps the edges of the cloth over the inner sole, where the whole is secured.

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35. For a *Washing Machine;* Horatio Hoskins, Scipio, New York, August 26.

We are under the necessity of omitting the claim in this instance, because of its reference to and dependance on the drawings.

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36. For an improvement in the machine for *Crimping Boots;* John Young, West Galway, New York, August 26.

The crimping jaws are made of metal and arched, and they are

pressed together by two curved connecting bars, the ends of which fit in recesses in the outside of the jaws, the connecting bars being connected together and with the lever by means of a screw bolt.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the arched jaws and curved spring, connecting bars, screw rod and lever, arranged and operated in the manner and for the purpose set forth."

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37. For improvements in the *Exercising Swing;* Joel H. Ross, New York city, N. Y., August 26.

The arms by which the swing is hung are made in two parts that slide on each other, with helical springs interposed; a cord is attached to the swinging frame and passes on each side, over a roller or a permanent frame, and thence extends down to the seat.

Claim.—"What I claim as my invention, and not before known, in the above described swing, and desire to secure by letters patent, is the application and use of springs in combination with the connecting rods, and in the construction of a swing, so that persons exercising thereon may receive the motion of a spring, in combination with the ordinary swing motion; and the manner of giving motion to the swing by means of the cord and pulley, or cords and pulleys, in combination with the swinging and stationary frames, as herein described."

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38. For an improvement in the construction of *Galvanic Rings, Belts, Bracelets, &c.;* David C. Moorhead, New York city, N. Y., August 26.

The ring is made in two parts of copper and zinc united by means of a wire spring, which permits the ring to yield to the body, &c.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the arched jaws and curved spring, connecting bars, screw rod and lever, arranged and operated in the manner and for the purpose set forth."

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39. For an improvement in the *Bee Hive;* Israel Lamborn, Marshallton, Chester county, Pennsylvania, August 26.

The tubes that form the entrance to the reception chamber are surrounded by two flanches, in the form of inverted cones, containing water, and the tube that forms the entrance from this reception chamber to the hive is surrounded by one such flanch also containing water, and within this tube there is a coiled wire which extends down a short distance into a cup of water, into which the moth will fall in attempting to get to the wire coil.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the mode of preventing the moth from entering the hive, and entrapping her by means of the upright metallic tubes and inverted truncated cones forming the entrance to the recep-

tion room of the hive, and the upright tube forming a passage between the chamber and lower box, all of said tubes being surrounded by inverted truncated cones, and containing water, and into which the moth is caused to fall, as described.

I also claim combining with the vertical tube a spiral rest upon which the bees cluster, in the manner and for the purpose set forth."

List of American Patents which issued in the month of March, 1842,—with Remarks and Exemplifications, by CHARLES M. KELLER, *late Chief Examiner in the United States Patent Office.*

1. For an improvement in *Propelling Vessels and Extinguishing Fires;* Stephen Bates and George Titcomb, Boston, Massachusetts, March 4.

The vessel is to be propelled by jets of water forced through horizontal tubes, open at the bow and stern, by means of vertical pumps provided with lateral tubes governed by cocks or valves for conducting the water from the pumps to any part of the vessel for extinguishing fires.

Claim.—"We shall only claim as our invention in the above described machinery, the propelling cylinders provided with valve pipes, conducting through the bottom of the vessel, and with horizontal pipes having stop cocks, in combination with the fire pipes of smaller diameter, arranged in the side of said propelling cylinders, and having suitable stop cocks substantially as described for propelling the vessel and extinguishing fire, and likewise exclusively for extinguishing fire, as described.

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2. For an improved method of making *Bridges for suspending therefrom Rail or other Roads;* Harvey Leach, Philadelphia, Pennsylvania, March 4.

Claim.—"Having thus fully described the nature of my improvement, and shown the manner of carrying the same into operation, I do hereby declare that I do not claim to be the inventor of suspension bridges, or of latticed or trussed framing to give strength and stability to chain or other bridges or similar structures; nor do I claim to be the inventor of either of the parts of the above described apparatus or structure, taken separately or alone; but what I do claim as constituting my invention, and desire to secure by letters patent, is the combining of a suspended platform with a suspension bridge, which suspended platform shall descend to the level and make a component part of a rail road, or other road, so that cars, carriages, or other articles, may be transferred directly from the stationary road to said platfrom, and moved from one side of the suspended bridge or structure to the other, by any adequate power applied thereto. The whole

being combined, arranged, and operating substantially as herein set forth."

3. For an improvement in the machine for *Sizing Paper;* Lorenzo D. Brown, Lee, Berkshire county, Massachusetts, March 4.

The paper passes under a roller (designated in the claim by the letter B) which runs partly in the size, then under another roller (D) still more immersed in the size, so that in passing from the one to the other both sides of the paper are sized; and then from the last roller (D) the paper passes between the roller (B) and another above it, by which the surplus size is removed.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the additional roller (D) located as herein described, in combination with the rollers (B and C,) by which arrangement the paper passes through the size, and the size has free access to both sides of the sheet between the rollers (B and D,) and by which also the wrinkles or folds formed by its expansion in passing through the size are removed before it reaches the press rollers; all as herein described."

4. For improvements in the "*Endless revolving platform Horse Power" for Driving Machinery;* John Kelley, Lewistown, Pennsylvania, March 4.

The links of the chain are made with projecting tongues or grooves, so as to interlock each other somewhat in the manner of rule joints. This chain runs on balls, the under surface of the chains and the upper surface of the rails being grooved for the guiding of the balls, and at the lower end of the rails there are troughs which receive the balls and conduct them down to be again received between the main wheel and chain; and to regulate their delivery at the end of each trough there is a shutter or valve, which is opened by a pin projecting from each link of the chain, which in passing opens the shutter and permits a ball to fall out.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is, 1st, constructing the links of the chain with tongues and grooves, in the manner and for the purpose set forth.

2d, The method of applying a continuous row of balls under the chain by means of the conductor, in combination with the trough as described for reducing friction.

3d, The arrangement of the drop or shutter in combination with the trough for regulating the descent of the balls."

5. For an improvement in the machine for *Cutting Shingles, Laths, &c.;* Hiram H. Herrick, Boston, Massachusetts, March 9.

The knife is connected at each end to a crank, so that by the rotation of the two cranks the fall of the knife gives a draw cut.

Claim.—"I shall claim arranging the ends of the knife which separates the shingles from the block of wood on cranks which are fixed

on horizontal shafts, so that when said shafts are revolved, the knife will descend through the block of wood with a lateral or drawing motion; the same being constructed and operating substantially as above described."

6. For a method of rendering *Chairs, Stools, &c., buoyant, to be used as Life Preservers on Vessels;* Wm. H. Shecut, New York city, N. Y., March 9.

Air-tight vessels made of sheet metal are hinged to the seat in such a way as to hang under the seat when used on board a vessel, but which, when used as a life preserver in the water, will suffer the seat to hang between them.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application to chairs, stools, settees or tables, used on board of vessels, of cylinders or cases containing air or gas hermetically sealed, so as to be perfectly air and water-tight, as described in the foregoing specification, combined with the hinges and strap or springs, all as herein set forth."

7. For improvements in *Hot Air Furnaces for Heating Buildings;* Otis Packard, Roxbury, Massachusetts, March 9.

Claim.—"Having thus described my improvements, I shall claim extending the smoke or discharge flue into the central part of the tubular radiator, and otherwise arranging it with a valve or damper at its lower end, and with orifices above said damper, and combining and surrounding said flue with a cylindrical or other proper shaped casing, which is connected to the flue at its lower end and extends upwards to within a short distance of the top of the radiator; the whole being constructed substantially in manner described, and for the purpose of causing the hot air, smoke, and other products of combustion arising from the fire-pot to more freely circulate about the upper exterior surfaces of the tubes of the radiator by the described combined arrangement of casings by which the cold air is taken in at the side of the furnace through an elongated opening, and a portion of said cold air caused more freely than in most hot air furnaces to circulate in contact with the exterior casings, by which they are rendered in a great measure non-radiating, while the remainder of the air passes in contact with the fire-pot and through the radiator; the whole being constructed substantially as above set forth.

Also, the mode of constructing the reflecting jacket or upper casing with doors, by which it may be easily removed at any time from the rest of the apparatus for the purpose before mentioned. Also, supporting the grate on a cylindrical rod passed through the sides of the ash-box, substantially in manner and for the purpose described."

8. For an improvement in *Hanging Carriage Bodies;* Jonathan Bacon, Bedford, Massachusetts, March 9.

Claim.—"I am aware that helical springs have been employed in

carriages to sustain the body of the carriage, but to my knowledge they have always been placed vertically or horizontally, and having no play, deviating from such positions relatively to the frame or body of the carriage, and therefore I do not claim the mere employment of helical springs in carriages; but what I do claim as my invention, and desire to secure by letters patent, is the arrangement of the springs, heads, rods or loops, in combination with the frame of the carriage and body—that is to say, having the rods that are attached to the heads or loops hinged to the frame and body of the carriage, for the purpose and in the manner herein specified."

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9. For improvements in the *Engine for driving Machinery by Steam or Water Power;* P. H. Green and H. H. Everts, Mount Morris, New York, March 9.

We are under the necessity of omitting the claims in this instance, as they refer to and are wholly dependant on the drawings.

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10. For improvements in the *Power Loom;* C. G. Gilroy, Great Britain,—assigned to Jeremiah Wilbur, New York, March 12.

This is for a loom combined with the Jacquard frame, which is necessarily very complex, and as the claims are wholly dependent on the plates, we are under the necessity of omitting them.

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11. For an improvement on the mode of *Propelling Vessels,* patented by Harris and Hunter, and known as the Hunter submerged propeller; Wm. W. Hunter, Gosport, Virginia, March 12.

The paddle wheels, which consist of paddles arranged on and projecting from the periphery of drums, rotate horizontally in cases within the vessel, and open at the sides sufficiently to permit the paddles in their rotation to project beyond the vessel. The present improvement is based on the supposition that although these wheels are below the water line, their rotation will, by centrifugal action, exhaust the central part of the case in which they are placed, and therefore he proposes to connect the exhaust pipes of the engine with these cases, that the wheels may act as air pumps, and thus make a condensing engine.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of the submerged paddle wheel for the purpose of an air pump to the steam engine, and the case in which the paddle wheel revolves as a condenser to the steam engine."

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12. For improvements in the *Reaping Machine;* Jonathan Read, New York, March 9.

Claim.—"I claim, and desire to secure by letters patent as my invention, the construction of the vibrating cutters with serrated edges,

whether said cutters be connected together so as to form a vibrating bar, or be placed separately on a bar of this kind, as set forth; in combination with the stationary teeth or blades serrated in similar manner, and arranged below the former, as described. I also claim the mode of constructing the rake and combining it with the bed of the machine, by forming it with pointed fingers on the ends of the arms, and arranging the fingers in spaces formed in the bed, as set forth. I also claim the manner of discharging the grain from the bed by means of said rake, and in the manner already described."

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13. For an improvement in the method of *Securing Bobbins in Shuttles;* John H. Coburn, assigned to Rosswell Douglass, Lowell, Massachusetts, March 12.

The flanch or bottom of the bobbin is grooved, and is let into a recess in the shuttle, at the bottom of which recess there is a piece of metal with a semi-circular rim that fits the groove to hold the bobbin steady; when inserted the bobbin is held steady by the end of a spring lever which bears on the flanch.

Claim.—"Having thus described my invention, I shall claim securing the bobbin in the shuttle by means of the spring lever, combined with the semi-circular angular piece; the whole being arranged and operating substantially as described."

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14. For an improvement in the method of *making Brushes;* J. I. Adams, Boston, Massachusetts, March 12.

The holes in the block are made entirely through, and a bunch of bristles doubled up is introduced in each hole from opposite sides, the wire by which the bristles are fastened being first passed through the hole in the opposite direction, then passed around the bristles before they are doubled up, and then the wire is again passed through the hole; the same plan being adopted on each side, the mere pulling of the wires will draw in the two bunches of bristles and hold them.

Claim.—"Having thus set forth my invention, I shall claim constructing the double brush by boring holes entirely through a block and inserting two bunches of bristles in each of said holes, so that each bunch shall project from one side of the block in an opposite direction to that of the other bunch, and drawing and confining said bunches of bristles in said hole by two wires, as herein before explained; the whole arrangement and process being substantially as described."

MECHANICS, PHYSICS, AND CHEMISTRY.

On the Crystaline Fracture of Wrought-Iron, and the causes of the same. By M. Aug. Malberg.

[From the Bulletin du Musée de l'Industrie.]

The accidents originating in the breaking of locomotive engine and railway carriage axles have given rise to enquiries and experiments, as to the quality of the iron of which such axles had been made.

The surfaces of the fractures which were examined presented large crystals, and as the axles had mostly been in use a considerable time, the conclusion arrived at was, that the crystaline texture resulted from the action to which the axles had been submitted whilst in use. The commission appointed by the French Government to institute enquiries on the occasion of the accident on the Versailles railroad, declared, that if the axles had been manufactured from iron possessing a strong tenacious fibre, the daily rotation and contact with the rails would give rise to electric or galvanic action, of such a nature as to produce changes in the body of the iron, so injurious, as regards its tenacity and ductility, as to render it quite unfit for use.

Mr. Charles Hood subsequently published an article, in which he maintained that the principal causes which produce a crystaline texture in wrought-iron, originally of a tenacious and fibrous nature, are shocks, elevation of temperature, and magnetism; and he adds that it is doubtful whether one of these forces alone would be sufficient to produce that effect, but there is every reason to believe that by the combination of all three these phenomena are produced.

The original texture of bar-iron is granular and angular. It is by being submitted to the action of the hammer or rollers that it acquires a fibrous texture, as by those means the crystals are drawn out and elongated. This is more especially the case when the rolling process is employed; for when the hammer is used, it is not unusual, especially in large pieces of iron, to find the interior granular, whilst at and near the surface it has become more or less fibrous. This difference or inequality in the texture arises from the fact that the blows of the hammer, whatever may be its weight, do not penetrate to the interior of the iron. The property possessed by the iron, of passing from a granular to a more or less fibrous state, depends upon the primitive quality of the iron; some pigs possess it to a less extent than others. Consequently, in order to judge of the texture of iron from a recent fracture, it is indispensably necessary to pay attention to the manner in which the fracture has been occasioned.

A fracture caused by loading a piece of iron in a longitudinal direction, or in the direction in which it has been rolled or hammered, will generally, in iron of good quality, be angular; the fibres are drawn out in fine points, and more so in rolled than hammered iron; it also presents a different aspect under incidental and reflected rays of light, being either of an ash grey or dead silver color, or a mixture of both. In order to judge of the quality of the iron from this, the

bar must be turned in every direction, and the light thrown upon all sides of the fracture and in the middle. When, under these circumstances, the fracture appears of a greyish color, with short fibres and very slightly angular, the conclusion may be safely arrived at, that it is iron of an inferior quality. It is, however, advisable to take into consideration whether the fracture was occasioned by a sudden shock, or by gradual augmentation of the charge. In the former case, the iron appears of a light grey color, more crystaline, with short fibres, and its fibres do not terminate in fine points; whilst, in the latter case, it is thready, and of a dead silver color under certain incidence of light.

When, on the contrary, the iron is broken in a direction at right angles with that in which it was rolled, (but in such manner as to take its absolute tenacity into consideration,) the fracture is always very short and the absolute resistance less. According to experiments by *Navier*, this resistance is 10 per cent. less in boiler-iron. The fracture in which the distinct strata or layers serving to form the bar, by welding, are perceptible, presents a flaky appearance; it is white when viewed by reflected light, and grey under incidental light; very often traces of fine steely grain are perceptible. It is in consequence of this being observed, that iron which is required to offer resistance in every direction, as, for instance, boiler-iron, is rolled, not only in the direction of its length and breadth, but also diagonally. The relative resistance is, in fact, less in a direction at right angles to that in which it was rolled; and pieces which require eight, ten, and even twelve blows with a hammer in order to break them in the direction of rolling, often break in the other direction at the third, fourth or fifth blow. This phenomenon is of the greatest importance in the construction of cranks of railway axles, which are wrought in one piece.

A fracture in a transverse direction (relative resistance) is always whiter when effected by striking the bar upon the edge of an anvil, than when produced by the pressure of a weight in a longitudinal direction, (absolute resistance,) and the cause of this is the different manner in which the reflecting faces are presented to the light; in general it is not so veiny as the fracture in the longitudinal direction. If the different layers or strata of which the bar is composed are not well welded together, they will separate, and form facets of greater or less extent and smoothness. If these layers have not been well purified before welding, black spots will appear, consisting of carbon, or other impurities, which prevent their becoming perfectly united. In order to prove that the bar is perfectly welded, it is drawn out into a thin sheet, at a heat below welding heat, and if no flaw is then perceptible, the welding has been perfectly effected.

When striking the iron in order to break it, the fracture may be more or less modified, according to the weight of the hammer employed, the force of the blow, or the length of the piece detached. A long piece of iron, hammered with small hammers in one direction only, always presents a very veiny fracture, whilst when operated upon with heavy hammers, it presents a short, fibrous, or crystaline

grainy texture. The fracture is always somewhat crystaline on its under surface, where the bar rested upon the anvil. When the fibres of the upper surface are broken or torn apart, those of the under surface are, in consequence, compressed or forced together, and shortened; these latter fibres are, therefore, seldom of a veiny character, but are generally of a fine steel-like grain. This is seen more especially when iron is broken by being bent backwards and forwards several times. I have often experienced this, and my observations on this head are in accordance with the experiments recently made on the Rhine railway, in which railway axles were broken, on the one hand, by means of a monkey weighing 1112 lbs. falling from a height of from 16 to 36 feet, and on the other by means of a hammer of very light weight.

I will state two of the experiments made upon the Rhine Railway, which appear to me to confirm the facts above stated:—A wrought or hammered iron axle, belonging to a railway wagon for transporting earth, was broken by the weight of 1112 lbs., falling a height of ten feet. The faces of the fracture were of a coarse crystaline character. The same axle, broken by several blows with the small hammer, presented all round the outside of the fracture a fine greyish grain, similar to cast-iron, and in the middle a grey crystaline texture. A rolled iron axle, which, on being broken by the weight, was crystaline, was, when broken by the small hammer, perfectly ductile and veiny.

On comparing the faces of the fracture of iron wrought by the hammer with that of rolled iron, the latter always appears more tenacious and veiny than the former. Forged iron is always of a less uniform character than rolled iron; it presents on the faces of the same fracture all degrees of texture, from the fine steel-like grain to the coarse crystaline grain, the whole combined with a veiny texture. In the former also more frequently than the latter, and especially in large pieces, flaws are met with, in consequence of imperfect welding. These facts arise from the rolling being performed in less time, and with more care and attention than work performed by the hammer. In this latter mode, too elevated a temperature may deteriorate the quality of the iron, and too low a temperature renders it brittle; a defect which may, doubtless, be afterwards remedied, but to which sufficient attention is not paid in forging.

In bars of rolled iron crystaline portions are frequently met with, which render those parts where they occur brittle. Amongst a great number of bars manufactured from the same pig iron, some will be found much inferior to others as regards the tenacity or veiny character of their texture.

In order to ascertain from what cause rolled iron acquires a crystaline texture in the process of manufacture, I undertook a series of experiments which I will now explain.

It is a well known fact, that when the pig iron does not remain a sufficient length of time in the puddling furnace, or when that operation is not properly performed, so that all its particles may be sufficiently separated and brought into suitable contact with the flame

passing over it, impure puddled iron will be obtained, containing portions of iron not completely refined, and also extraneous matter, such as silica, arsenic, sulphur, phosphorus, &c. This may be easily ascertained by the appearance of the fracture, which, in that case, will be grey and of an unequal character, of a short fibrous or coarse crystaline quality. It is also well known that if, after puddling and blooming, too low a welding heat is given under the hammer, a mechanical mixture of carbon and dross will remain in the iron (especially if, on afterwards passing it between the rollers, the pressure is not sufficiently strong,) and in that case the iron soon becomes brittle. It is, however, possible that, with too great a heat, the iron will retain its original granular texture, if it is not afterwards sufficiently worked, as will be seen from the following experiments:—

Choice was made of two puddling furnaces, both of which were charged with a similar quantity of the same pig iron, some days after putting them to work, and not till after they had acquired an equal temperature and worked regularly. This pig iron was worked in the same manner in both furnaces, and equal care was taken in performing the process of puddling. In one of these furnaces the blooms were removed immediately after refining, wrought under the hammer, and beaten flat to the size of about 6 inches in breadth and ¾ of an inch in thickness, and passed in this state through rollers having seven grooves. I then remarked, that under the hammer and between the rollers a large quantity of dross was separated, and the welding was effected with great facility.

In the other furnace the blooms were left 20 minutes longer, and then submitted to the hammer and rollers as before. By this mode of treatment less dross appeared in the blooms; but it appeared that the hammering and rolling were not performed with the same facility on these blooms of a dry nature; that particles of iron were detached even under the hammer; and that the bars, on coming from the rollers, were more flaky, and more full of flaws at the edges.

On examining the fractures made in these bars, the quality of the iron appeared in both cases identical. This fracture was of a fibrous quality, of a silver grey color, with here and there some projecting crystals; from this it was not thought necessary, during the other experiments, to classify the different sorts, and they were used indiscriminately.

I think proper to make an observation here upon the crystals, which were somewhat abundant in the iron after the first operation of the rollers:—When these crystals are very fine and of a clear color, their quality is good; they will disappear on being passed consecutively through the rollers; and the iron will be of very fine quality when the rolling operation is finished. This fact is well known in iron-works; and care is taken to put these crystaline bars on one side, as they are not required to be submitted to the test usually made of the work of the puddler. I have convinced myself of the truth of this by forging a fine granular bar, which had passed through the first operation, and which, under the hammer, acquired a fine fibrous texture.

By this means the fact is therefore confirmed, that suffering the bloom to remain for any length of time in the puddling furnace has not an injurious influence upon the quality of the iron produced. It is, however, as well to remark, that in that case there will be greater waste of iron owing to the friability or dryness of the metal under the hammer. But it is also to be observed, that, by prolonging the application of heat in the puddling furnace, iron of good quality may be manufactured from pig iron of inferior quality. From this fact it has been proposed to apply heat for a longer time with an open register; a plan by which, it is true, better iron may be produced from an inferior material, but which has, however, been for the most part abandoned, as from the waste, consumption of fuel, and loss of time, the iron produced is more expensive than if pigs of the best quality had been employed.

In order to determine the degree in which, in the successive operations of heating in the welding furnace, hammering into rectangular bars, and rolling, a change takes place in the iron, the following experiments were made:—

After examining the surfaces of fracture of all the rolled bars, and sorting them, they were made up into bundles of eight bars deep, and about five feet long, introduced into a welding furnace, and forged with a hammer of 2000 lbs. weight into rectangular bars, which were again introduced into the furnace, and afterwards rolled into bars of about $\frac{3}{4}$ of an inch in thickness.

The pile, No. 1, was suitably heated and forged.
——— No. 2, ditto.
——— No. 3, was strongly heated and forged.
——— No. 4, less heated and forged.

Previously to passing them through the rollers they were operated upon as follows:—

No. 1, was again heated to a high temperature.
No. 2, — heated to the ordinary welding heat.
No. 3, — heated at a higher temperature than No. 1, until the upper part was burned and half converted into waste.
No. 4, — kept at the ordinary welding heat.

On examining a fracture made in the bars after rolling, the following results were observed:

No. 1, which was kept at a good welding heat, both before hammering and rolling, had a clear and even fracture; some very small crystals were perceptible in several places, but they were for the most part oblong and not angular.

No. 2, also kept at a good welding heat, both before hammering and rolling, had a clear and even fracture, but some crystals were already perceptible.

No. 3 was brought to a great heat, both before hammering and rolling. The portion of the bar which was the most affected by the excess of heat, and which might besides be distinguished by its exterior flaky appearance, presented brittle edges, a structure entirely crystaline, and with very fine grains. Another portion, a little farther

from that point, was half crystaline and half fibrous, but with short fibres. A third portion, nearer the extremity, was of a short fibrous texture, and had some small projecting crystals.

No. 4, which before hammering was less heated, and only carried to a suitable temperature before rolling, presented a fibrous texture, with some very small crystals, and was very similar to No. 2.

The granular portion of No. 3, having been heated nearly to welding heat, and again forged with a small hammer, the crystaline texture disappeared, and was changed into a short fibrous texture. The portion, a little less granular, of No. 3, treated in the same manner, was of a fine fibrous texture, of good quality, and a fine clear color.

The following facts result from these experiments, viz:—

That No. 2 produced a fibrous iron, without crystals, when brought to a perfect welding heat, without, however, being overheated. No. 3 furnished a granulated iron when the heat was too great. No. 4 preserved its fine fibrous texture, even when overheated before hammering, when not overheated in the furnace before the consecutive rolling.

No. 1 furnished a more granulated texture when heated before the last rolling, than when heated before the hammering; and, lastly, the principal result of this latter mode of treatment is, that the iron easily becomes deteriorated; but that iron, which by a previous operation has been overheated, and has consequently become granular, may be brought back to the fibrous state. The experiment made by re-forging the granular iron, No. 3, is also in favor of this conclusion.

In practice, the property which wrought-iron possesses of becoming granular under a great heat, is profited by. In fact, it has often been proved, that iron with a very fine grain may be easily drawn very fine without flaw, and even be cut in small dimensions without flying to pieces or breaking. It is from this observation that all nail-iron is split whilst very hot. The nails manufactured are perfectly pointed, without flaws, and may be tempered to any degree of hardness and tenacity required.

(To be continued.)

Iron and Coal Statistics: being Extracts from the Report of a Committee to the Iron and Coal Association of the State of Pennsylvania, 1846.

By the census of 1840, the number of Furnaces in Pennsylvania was 213—Rolling Mills, Bloomeries and Forges, 169. In March 1842, returns were procured, with great industry and labor, from the following seventy-nine of these Furnaces, being 72 Charcoal and 7 Anthracite Furnaces:—

Names of Furnaces.	Counties.	Proprietors.	Pig Iron.	No. of hands employ'd.
Hopewell,	Bedford,	D. Loy & Co.	960	70
Sarah,	"		1,282	74
Elizabeth,	"		1,478	85
Hopewell,	"	Milliken & Benedict,	800	60
Moslem,	Berks,	N. V. R. Hunter,	600	60
Mount Penn,	"	John Swartz,	1,000	73
Oley,	"	A. U. Snyder,	800	65
Joanna,	"	Darling & Smith,	700	80
Phœnixville,	Chester,	Reeves & Whitaker,	1,100	67
Warwick,	"		400	56
Isabella,	"	Potts & Rutter,	800	55
Greenwood,	"		800	30
Logan,	Centre,	Valentines & Thomas,	1,100	70
Howard,	"	Valentines, Harris, & Co.	1,200	70
Centre,	"	James Irvin & Co.	1,200	70
Hecla,	"	W. W. Houston & Co.,	1,100	65
Eagle,	"	R. Curtin & Sons,	1,100	65
Julianna,	"	David Adams,	800	40
Washington,	Clinton,	Irvin, Pyle & Co..	1,0[illegible]0	70
Lucinda,	Clarion,	J. Reynolds & Co.,	1,2[illegible]0	70
Shippensville,	"	Shippen & Black,	1,200	69
Beaver,	"	Long, Blackston & Co.,	1,200	71
Madison,	"	Matthiot, Miller & Co.,	1,000	70
Jefferson,	"	A. Plummer & Co ,	800	69
Clarion,	"	C. Myers	1,200	70
Clinton,	"	Clapp & Seymore,	1,000	70
Montour, 3	Columbia,	Thomas Chambers, Anthracite	7,800	175
Columbia.	"	Paterson,	1,440	35
Roaring Creek,	"	T. Dunlap,	1,450	36
Port Royal, 2	Dauphin,	J. Jewett & Sons,	2,500	80
Mt. Pleasant,	Franklin,	S. Dunn,	1[illegible]0	20
Southampton,	"	Charles Wharton,	850	75
Carrick,	"	Dunn & Bard.	400	40
Montalto,	"	S. & H. Hughes,	8[illegible]0	120
Caledonia,	"	J. D. Paxton & Co.,	8[illegible]0	75
Mill Creek,	Huntingdon,	J. H. Dorsey & Co ,	1,0[illegible]0	70
Springfield,	"	S. Royer & Co.,	1,2[illegible]0	75
Alleghany,	"	E. Baker & Co ,	1,5[illegible]0	110
Etna,	"	H. S. Spang,	1,200	80
Rebecca,	"	Shoenberger & Co ,	1,400	82
Huntingdon,	"	"	1,700	92
Elizabeth,	Lancaster,	Coleman's Estate,	1,3[illegible]5	100
Mt. Vernon,	"	E. B. Grubb,	1,450	75
Mt. Hope,	"	"	1,450	75
Colebrook,	Lebanon,	Coleman's Estate,	1,500	120
Cornwall,	"	"	1,5[illegible]0	100
Monroe,	"	S. B. Seidel,	500	30
Catawissa,	Columbia,	Lloyd & Thomas,	700	41
Liberty,	"	Thomas Dunlap,	1,000	70
Esther,	"		1,5[illegible]0	110
Berwick,	"		700	41
Pinegrove,	Cumberland,		900	125
Brookland,	Mifflin,	M. Crisswell & Co ,	1,200	75
Matilda,	"	Cottrell & Penn,	1,500	50
Union,	Huntingdon,		1,250	68
Greenwood,	"	Rawle & Hall,	1,000	56
Perry,	Perry,		300	35
Juniata,	"	Fisher & Co.,	500	45
Oak Grove,	"	Pleiss,	600	60
Caroline,	"	Fisher & Co.,	800	45
Montebello,	"	"	1,400	60
Swatara,	Schuylkill,	Eckert & Guilford,	1,400	75
Codorus,	York,	E. & C. B. Grubb,	1,400	75
Margaretta,	"	H. Y. Slaymaker & Co.,	900	90
York,	"	S. R. Slaymaker & Co.,	1,000	70
Maria,	Northampton,	Smith & Richards,	1,200	75
Jackson,	Venango,	Parker & Royer,	800	47
Venango,	"	David Phipps,	700	45
	"	Cross & McKee,	500	35
	"	M. & J. McConnel,	500	37
	"	L. R. Reno,	700	48
Van Buren,	"	Hoyt & Cross,	700	46
Slab,	"	Jas. Hughes,	500	38
Webster,	"	Dempsey & Wicks,	700	45
	"	C. Shippen,	800	48
Horse Creek,	"	Bell & Davison,	500	38
		Tons,	84,885	

From the following thirty Rolling Mills:

NAMES OF WORKS.	Location and Proprietors.		Bar Iron.	Boiler Plate.	Sheet Iron.	Nails.	No. hands employed.
Rolling Mill,	Pittsburg,	H. S. Spang & Co.,	900	150	150	800	100
" "	"	Shoenberger & Co.,	3,000				150
" "	"	Lyon, Shorb & Co.,	2,000	250	250	500	150
" "	"	Bissell & Co.,	2,200			1,000	210
" "	"	Miltenberger,	1,500				80
" "	"	Laurentz & Co.,	2,000				100
" "	"	Kings, Higbee & Co.	500			1,000	80
" "	"	Smith, Royer & Co.,	500			1,000	80
W. Brandywine "	Chester co.			400			11
Caln " "	" "				200		12
Triadelphia " "	" "			400			12
Hibernia " "	" "			400			10
Brandywine " "	" "			400			11
Rokeby " "	" "			400			11
Lowell " "	" "		300		200	60	12
Bellefonte " "	Centre "	Valentines & Thomas	900				12
Howard " "	" "	Valentines, Harris, Co.	900				12
Milesburg " "	" "	James Irvin & Co.,	900				12
Eagle " "	" "	R. Curtin & Sons,	900				12
Fairview " "	Cumb'd "	A. O. Heister,	700			300	35
Duncannon " "	Perry "	W. L. Fisher,	1,100			1,000	180
Montalto " "	Franklin "	S. & H. Hughes,	500			100	25
Conshohocken " "	Mont'y "	J. Wood & Son,	400		200		30
Norristown " "	" "	Reeves & Whitaker,				1,000	50
Reading " "	Berks "	Keim, Whitaker & Co.	1,400			200	90
Phoenixville Nail Factory,	Chester "	Reeves & Whitaker,				1,300	52
Mason's " "	" "	R. W. Mason & Co.,				1,000	42
Lowell " "	" "					60	16
Brandywine " "	" "					100	6
Vartic Rolling Mill,	Lancaster,	Coleman's Estate,	200		200	600	40

From the following fifty-four Forges:—

NAMES OF WORKS.		LOCATION AND PROPRIETORS.		Bar Iron.	Boiler Plate.	No. hands employed.
Bedford	Forges.	Bedford,	S. King & Co.,	307	140	40
Hopewell	"	"	D. Loy & Co.,	200	150	30
Do.	"	"	Milliken & Benedict,	200	100	25
Maria, 3	"	"	Shoenberger & Co.,	2,081		107
Martha	"	"	Do.,	922		55
Dowell	"	Berks,	J. Seidel,	300		25
Union	"	"	George Regan,		40	8
Rockland	"	"	A. U. Snyder,		100	20
Gibraltar, 3	"	"	S. Seyfort,	500	140	58
North Kill	"	"	Joseph Seyfort,	450		40
Coventry	"	Chester,		225		14
Springton	"	"		325		15
Hibernia	"	"		300		17
Mary Ann	"	"			200	17
Pleasant Garden	"	"			200	16
Bellefonte	"	Centre,	Valentines & Thomas,	900		45
Howard	"	"	Valentines, Harris & Co.,	900		45
Milesburg	"	"	James Irvin & Co.,	800		45
Eagle	"	"	R. Curtin & Sons,	700		35
Washington	"	Clinton,	Irvin, Pyle & Co.,	300	100	40
Catawissa	"	Columbia,			150	15
Berwick	"	"			200	20
Liberty	"	Cumbl'd,	H. G. Moser & Co.,	325		25
Laurel	"	"		250	200	40
Valley	"	Franklin,			60	20
London	"	"			60	20
Mount Pleasant	"	"	Dunn & Bard,	60	120	18
Montalto	"	"	S. & H. Hughes,		500	40
Caledonia	"	"	S. D. Paxton & Co.,	35	195	23
Barree	"	Hunt'don,	S. M. Green & Co.,	900		60
Franklin	"	"	S. Royer,	450		25
Etna	"	"	H. S. Spang,	800		60
Antes	"	"	Graham & McCamant,	400		30
Juniata	"	"		1,225		58
Speedwell	"	Lanc'ster,	J. Reynolds,		250	30
White Rock	"	"	J. Alexander,		200	20
Vartic, 3	"	"	Coleman's Estate,	1,000		65
Union	"	Lebanon,	J. B. Weidman,		200	25
Monroe	"	"	J. B. Seidel,	200		25
Freedom	"	Mifflin,	Rawle & Hall,	650		33
Brookland	"	"	M. Crisswell & Co.,	700		70
Rebecca	"	"	Rogers & Co.,	325		17
Fio	"	Perry,		450	100	45
Berwick	"	Schuylkill,	D. Focht,		100	25
Hecla	"	"	P. & M. Jones,		100	20
Castle Finn	"	York,	Coleman's Estate,	125	250	45
Spring	"	"	J. Harmer,		250	50
Woodstock	"	"	H. Y. Slaymaker & Co.,	420		45

These furnaces, it will be perceived from actual returns, had been or were capable of producing 84,885 tons of pig metal; being an average of 1,074 tons to the furnace. But as this list embraced some large anthracite furnaces and the best of all the charcoal, the make of the remainder was small in comparison, and we shall therefore esti-

mate it at 500 tons to the furnace, (134 furnaces,) which will give us 67,000 tons more, being the make of only 62 good furnaces, the names and returns of some of which we are able to furnish:

	NAMES.	LOCATIONS.		PROPRIETORS.	Tons.
1	Pennsylvania,	Huntingdon County,		Lyon, Shorb & Co.,	1,500
2	Bald Eagle,	Do.	"		
3	Blossburg,	Tioga	"		
4	Mauch Chunck,	Lehigh	"	Smith & Richards,	600
5	Manda,	Dauphin	"	Robinson,	1,980
6	Mill Hall,	Chester	"	Reynolds & Morris,	
8	Martha,	Centre	"	Curtin,	
9	Helen,	Clarion	"	Barber & Packer,	
10	Sarah,	Bedford	"	Shoenberger,	1,500
11	Sally Ann,	Berks	"	Hunter,	
12	Lehigh,	Lehigh	"	S. Balliett & Co.,	833
13	East Penn,	Carbon	"	Do.	800
14	Cumberland,	Cumberland	"	Miller,	800
15	Green Lane,	Montgomery	"		
16	Monroe,	Lebanon	"	J. Seidell,	
17	Mary,	Franklin	"	Boyce & Wharton,	700
18	Maple,	Butler	"	G. Boward & Co.,	
19	Conowingo,	Lancaster	"	Hopkins,	800
20	Reading,	Berks	"	Robinson,	1,500
21	Carbon,	Carbon	"	S. Colwell,	
22	Victoria,	Dauphin	"	H. M. Bazard	700
23	Emeline,	Do.	"	Do.	700
24	Root,	Lancaster	"	Brooks,	
25	Big Pond,	Cumberland	"	Moore,	600
26	Carlisle,	Do.	"	M. Ege's Estate,	700
27	Mary Ann,	Do.	"	E. Jackson & Co.,	1,200
28	Augusta,	Do.	"		
29	Earl Farr,	Berks	"	Spang,	540
30	Julianna,	Centre	"	Jno. Adams,	
31	Mary Ann,	Berks	"	H. Trexler,	
32	Chester,	Chester	"	Pennypacker,	

Making the entire product 151,885 tons of pig metal; provided all these furnaces had been in active operation, but the fires of most of them had been extinguished.

This being their make previous to 1842, it is fair to suppose that these same furnaces, from the large use of the hot blast, economy of fuel, iron blowing cylinders and *high prices*, have increased at least twenty-five per cent.; which will give us a make for those furnaces of 189,856 tons. Now, to this we must add the new works that have been erected since 1840, and those not reported from in 1842, and which are as follows:—

List of Charcoal Furnaces in Pennsylvania built since 1840.

Built.	Erecting	NAMES.	PROPRIETORS.	Location. County.	When Erected.	Prod'ct in 1845. Tons.	Capacity. Tons.
1		Gap	Shoenberger	Huntingdon,	1845	1,500	1,500
1		Cambria	P. Shoenberger	Cambria	1844	1,500	1,500
1		Bloomfield	do.	Bedford	1846	1,050	1,050
1		Pike	Lansom, Duff & Orr	Clarion	1845		1,700
1		Anandale	Hunter & Sproul	Mercer	1843	600	600
1		Middlesex	Senate, Grey & Co.	do.	1845		1,200
1		Clay	Hennond & Vincent	do.	"		1,200
1		Martha	Powel & Sons	do.	1844	800	800
1		Big Bend	McFarland & Fling	do.	1845		1,000
0	5	Mercer	Names unknown	do.	1845		4,000
1		Mahoning	Shunk & Calwell	Armstrong	"		1,000
1		Elk	Wm. B. Fitzhugh	Clarion	1843	800	1,000
1		Deer Creek	Kerr & Hasson	do.	1844	1,000	1,100
1		Buchanan	Plummer, Creasy & Co.	do.	1844	1,000	2,000
1		Mary Ann	John Black & Co.	do.	1845	800	1,000
1		Polk	C. Meyer	do.	1845		1,000
1		Sligo	Lyon, Shorb & Co.	do.	"		1,500
1		Washington	Henry Blackstone & Co.	do.	"		1,000
1		Tippecanoe	Black & Maxwell	do	"		1,000
1		Cochego	John & Samuel Wilson	do.	"		1,000
1		Limestone	Jacob B. Lyan & Co.	do.	"		1,000
1		Wild Cat	Flick & Lawson	do.	"		1,000
2		Callinsburg	Alexander & Co.	do.	"		1,000 1,000
1		Monroe	Cochran & Fulton	do.	"		1,000
1		Hemlock	Fitzu & McGuire	do.	"		2,000
1		Perry	Welsh & Co.	do.	"		1,000
1		Licking Creek	Ohler, Ligworth & Co.	do.	"		1,200
1			John Nott	Bedford	"		750
1		Christiana,	John Gamber	Dauphin	"		1,250
1		Red Bank	Reynolds & Ritchie	Armstrong	1843	1,600	2,000
1		Indiana	Elias Baker	Huntingdon	1843	1,400	1,750
1		Lemnos	Wm. Lane	Bedford	"	230	500
2		Elizabeth	J. M. Bell	Huntingdon	1842	800	1,200
1		Brady's Bend, (coke)	Great Western Co.	Armstrong	1840-2-5	5,134	10,000
1		Mount Vena (Pero)	Leiss	Schuylkill	1841	600	1,000
1		Temperance	J. Ward & Co.	Mercer	"	500	1,200
1		Leesburg	Crawford & Co.	Do.		500	
1		Windsor	Darragh & Jones	Berks	"	500	900
1		Winchester	Davis & Beaty		1846		1,000
39	5					22,214	50,000
4		New furnaces in Mercer county, not included above,					4,000
				Forward,		22,214	54,000

List of Charcoal Furnaces in Pennsylvania.—CONTINUED.

Built.	Erecting.	NAMES.	PROPRIETORS.	Location. County.		Prod'ct in 1845 Tons.	Capacity. Tons.
43	5				For'ard	22,214	54,000
1		Franklin	Reynolds & Co.	Venango		1,000	1,000
1		Union	Williams & Looper	do.			1,000
1		Valley	Lee & Rhodes	do.			1,000
1		Texas	Wm. Porter	do.			1,000
1		Clay	Edward Evans	do.			1 000
1		Victory	A. & A. D. Bonnear	do.			1,000
1		Roymelton	A. W. Raymond	do.			1,000
1		Clintonville	W. Cross	do.			1,000
1		Slab	James Hughes	do.			1,000
1		Mill Creek	Charles Shippen	do.		1,200	1,200
1		Rockland	Spear	do.			1,000
1		Sandy Creek	McKee & Harris	do.			1,000
1		President	Klapp	do.			1,000
1		Bulyon	P. Rarradon & Co.	do.			1,000
1		Clinton	Moore & Seymour	do.			1,000
1			Bakers	Cambria		1,000	1,000
1			McKeenan & Co.	" Lockport		1,000	1,000
	1		Livegood, Linten & Co.	" Johnst'n			1,000
	1		Huber, Linton & Co.	Somerset " Milerun			1,000
1		Mill Creek	King, Shoenberger & Bell	Cambria		1,000	1,000
1		New Furnace	do. do.	Somerset, on Paint creek.		1,000	1,000
1		Shade Furnace				1,000	1,000
2			Stewart, Riter & Co.	Cambria		2,000	2,000
65	7						
					Tons	31,414	78,100
					Men	1,687	4,230
					Horses	740	2.200

These sixty-five charcoal and two coke furnaces will give us *a product* for this year of at least 75,200 tons

List of New Anthracite Furnaces in Pennsylvania.

Built.	Erecting.	NAMES.	PROPRIETORS.	Product in 1845. No. of tons returned.	Capacity. Tons for 1846.
2	1	Lehigh Crane Iron Works	Crane Iron Company	7,100	13,000
3		Phœnix Works	Reeves, Buck & Co.	1,210	9,000
1		Pioneer	G. G. Palmer	860	1,800
2		Glendon Iron Works	Charles Jackson	4,324	6,500
1		Henry Clay	Eckert & Brother	960	4,000
	1	Montour Works	Montour Iron Co.		5,000
1		Shawnee	Holmes, Myers & Co.	1,085	1,750
2		Bloomsburg	Paxton, Fisher & Co.		9,000
1		Harrisburg	David R. Porter	1,505	3,500
1		Wm. Penn	Livingston & Lyman	300	3,500
1		Mauch Chunk	Geateau & Co.		1,000
1		Valley	Pomeroy & Harrison		1,750
1		Spring Mill	Farr & Kunze	1,600	2,500
1		Conshohocken	Calwell & Elliot		3,500
1		Shamokin	Shamokin Iron Co.		2,500
1		Chickawolingo	E. Halderman & Co.		2,500
1		Halderman	P. Halderman's		2,500
2		Elizabeth	F. Goodill	1,500	3,500
1	1	Saint Clare	Burd Patterson		3,500
1	1	Lackawanna	Scranton	2,000	5,000
1		Sarah Ann	Porter & Stewart	400	2,000
1		Red Point	Samuel R. Wood		3,750
1		Birdsboro'	E. & G. Brooks		1,750
	1	Seyfert & McGuarn's			3,500
	2		Bevan & Humphrey	9,000	7,000
	1		Coleman		3,500
28	8	—36 furnaces		22,844	107,200

New Anthracite Rolling Mills.—Annual Manufacture.

			Tons.
1.	Wilkesbarre—Thatcher T. Payne,	Rail Road and Plate,	6,000
2.	Montour—Murdoch, Leavitt & Co.,	Do. Actual product,	10,000
		Plate,	1,000
3.	Reading—Sabbata & Co.,	Axles,	1,000
4.	Do. Jones & Co.,	Small Iron,	
5.	Little Schuylkill,	Do.	500
6.	Pottsgrove,	Rail Road Iron,	2,000
7.	Norristown,	Do.	3,000
8.	Schuylkill, Phil'a—Thomas & Co.,	Small Iron,	2,000
9.	Manayunk,	Plate,	500
0.	Phœnixville,	Rail Road Iron,	6,000
13.	Delaware, 3 near Phil'a.,	Plate,	3,000
14.	Harrisburg,		1,500

COKE.

15.	Brady's Bend, Great Western Co.,	Rail Road Iron, actual product,	5,000
		Plate,	1,000

The account for 1846 will therefore stand thus:—

	Furnaces.	Tons.
Charcoal	206	173,369
Anthracite	7	16,487
Furnaces up to 1842	213	189,856
New Charcoal since 1842	67	75,200
" Anthracite "	36	103,000
	316	368,056

Increase on Old Furnaces	37,971 tons.
Do New do	178,200 do.
	216,171 do.

More than 100 per cent. since the bill of 1842. This prodigious increase of the business has, of course, called for a large investment and employment of capital, which, after much reflection and experience, we estimate at $47·00 per ton for every ton of charcoal pig metal manufactured; this would therefore give on 75,200 tons $3,534,400; and for every ton of anthracite pig metal $25·00 per ton $2,575,000 —making the enormous sum of six millions one hundred and nine thousand and four hundred dollars, invested in furnaces alone, since 1842. The aggregate capital, therefore, would be calculated upon the same estimate:

	Tons.	Capital.
Charcoal Furnaces previous to 1842	173,369	$ 8,148,343
Anthracite do. do. do.	16,487	412,075
	189,856	8,560,418
New Charcoal Furnaces	75,200	3,534,400
Do. Anthracite do.	103,000	2,575,000
	368,056	14,669,818

This quantity 368,056 T. at $30 per ton, would be worth	$11,040,000		
It is probable that one half of this metal is converted into bar, hoop, sheet, boiler iron and nails, at a cost of at least $50 per ton more,	9,201,400		
	20,241,400	Capital for conversion at $20 per ton	3,680,560
The other half into castings at $20 per ton	3,680,560	Do. at $10	1,840,280
	$23,921,960		$20,190,658

And where does this enormous sum of money go, and how is it expended? All in labor and agricultural products—for of what mate-

rials is iron composed—coal, limestone, iron ores, sand and fire-clay—almost worthless unless converted into iron. The number of men employed in producing the above iron, would be in the charcoal operations one man to every twenty tons, and in the anthracite one man to every twenty-four tons of pig metal. This includes all the miners of coal and limestone, wood-choppers, &c., &c. Upon this estimate there would be employed, Charcoal 12,428, Anthracite 4,978 = 17,406. Allowing a wife and four children as sustained by this labor, we have a population of 87,030. To which, if we add the labor employed in its conversion into bars, hoops, sheets, boiler plate, nails, castings, railway iron, &c., &c., which would more than double those *directly* dependent, we should have upon this supposition 174,060 men, women and children. But when we look still further at the labor created by this business in railways, canals, &c., who can estimate it—both of man and horse?

Has not this increase of business been sufficient to satisfy the most ardent mind, and to realise ten-fold the predictions of the friends of that bill? Indeed this increase is only the result of two years, for so great was the depression and prostration of all the industry of the country, that the trade did not revive until 1844. During 1843, it will be perceived from the prices which we have given of iron during that year, that it was at the *lowest* point—the bottom of the wheel—and that although each revolution after 1843 brought up the price, yet it was very slow and gradual, and we are not aware of any new erections until 1844. The price of English iron remaining during the year 1844 at £5 0 0, and railway iron at £4 10 0. The most gratifying result in this increase of business, however, is the progress which we have made in the manufacture of railway iron, for it was asserted by even some of the friends of the Tariff, that so high a degree of skill and invention was necessary to manufacture this iron, that we must continue our deplorable dependence upon England for it—that we had neither "the minds to devise, or hands to execute, any such work"—that any attempt to make it, in the present infancy of our manufactures, would be disastrous, unless aided by a farther bounty from the government. But fortunately for us, this speedy production of it has settled this question, and shown that American energy and perseverance is equal to any work that can be accomplished by any other people in manufacturing pursuits. How supremely ridiculous to entertain the idea of an importation of materials for the construction of the roads of a country, and particularly such a country as ours, where these massive rails are to be stretched from one limit of the country to the other—East and West, North and South—in every direction, and wherever occasion may exist, and a dense and thriving population may demand passage or transportation.

It is not only gratifying that we have furnished this evidence of our skill and energy, but still more so that we have actually sold it at a *less price here* than it could be imported *free of duty*. When railway iron advanced in England to £15 10, $77·50, the Mount Savage Iron Works in Maryland were at this time furnishing it at fifty-nine dollars per ton, delivered at Baltimore to the Fall River Company, in

Massachusetts. The English iron, with a twenty per cent. duty, would have cost them at that time \$97·50 per ton. We are now manufacturing, as it appears from the returns herewith made, of railway iron, in this State alone, 15,000 tons per annum, and so strong is the disposition to embark capital largely in this manufacture, that we entertain no doubt that the supply of railway iron from our own establishments in 1847, *will be equal to the wants of the country*, and this will all have been accomplished in about *three years*, and we challenge the world for a like result. This iron will be manufactured entirely from our mineral coal metal, and thus open, for works of that description, an endless field—leaving to the charcoal works the manufacture of the smaller sizes of iron, and all that is requisite for the finer purposes of cutlery, &c. We are glad to find in the mills that are now being erected, that it is the intention of the Proprietors to confine their manufacture exclusively to railway iron, which will soon bring it to the highest perfection, and reduce its cost to the lowest figure. It has been this same system under high duties that perfected our manufacture of *nails*, which, when the duty was five cents per pound, were selling at 3½ to 4 cents. The perfection of this manufacture has been so complete as to defy the competition of the world, and its magnitude is almost beyond belief. As we have never yet seen in print a list of the nail works, and their product, we furnish the following, under the hope that it may lead some person of leisure to perfect it:—

State.	Place.	Names.	Machines.	Proprietors.	Kegs.
Maine,	Saco,				15 000
Massachus'ts,	Dover,				10,000
	Boston,	Boston Iron Co.,		Horace Gray, (burnt,)	40,000
		Weith Iron Co.,			10 000
	Weymouth,	W. Iron Co.,		Lazell, Parkins & Co.	35,000
	Bridgewater,			do. do. do.	15,000
	Fall River,	F. R. Iron Works,		Borden Manager,	60,000
	Taunton,	Old Colony,		Crocker & Brother,	40,000
	Plymouth,			Russell,	20,000
	Braintree,			Randall & Howard,	20,000
	Wareham,	Agawam Nail Co.,	29	S. T. Tisdale & Co ,	35,000
	Do.	Washington,		Haywood and others,	30,000
	Do.	Tihanet,		Parker,	10,000
				Toby,	10,000
Connecticut,	Norwich,				8,000
New York,	Troy,	Albany Iron and Nail Works,	34	E. Corning & Co.,	20,000
	Do.	Troy Iron and Nail Works,	28	H. Burden & Co.,	12,000
		Peru Iron Co.,		Saltus & Co.,	20,000
		Sable Iron Works,		Royers & Co.,	30,000
		Keesville Man. Co..		Hurlbut,	10,000
		Eagle Nail Co.,		Kingsland,	15,000
	Clintonville,		25		20,000
	Forks,		28		20,000
New Jersey,	Bridgeton,	Cumberland,	47	Reeves, Buck & Co.,	40,000
Pennsylvania	Norristown,	Nor. Works,	29	Reeves, Buck & Co.,	25,000
	Phoenixville,	Phoenix Works,	38	do. do.	35,000
	Phoenixville,	Sansinak,	20	Jaudons & Mason,	18,000
	Reading,	R. Iron Works,	24	Seifert, M'Manus, &Co	20,000
	Port. Iron works	Portagelo,		McMarnara & Royer,	14,000
	Easton,		12	Rodenbaugh Stew't co	10,000
	N. Castle,		12	Crawford & Co.,	8,000
	Farrandsville,	Franklin,	20	Lyman & Co ,	10,000
	Bellefonte,		18	3 small works,	6,000
	Colebrookdale,	Colebrook,			8,000
		Mount Alto,	12	H. Hughes,	6,000
	Harrisburg,	Duncannan,	28	Morgan and Fisher,	25,000
	Coatesville,		6	Buckley & Co.,	3,000
	Delaware Co.,		8	Edwards,	4 000
	Brownsville,				20,000
	Lancaster,	Colemanville,		E. T. Coleman,	6 000
	Wilkesbarre,		24		12,000
	Milesburg,	Eagle,		C. & J. Curtain,	1,000
	Pittsburg,	Alleghany Iron Works,	14	Russell, Sample & Co..	14,000
		Etna,		Sprong & Son,	16,000
			30	J. Shoenberger,	40,000
			27	King & Higby,	20,000
			17	Miller & Brown,	12,000
			14	Smith, Rogers & Co.,	10,000
		Kensington Works,	20	Freeman, Miller & Co.	16 000
		Birmingham,	4	Wood, M'Knight&Co.,	2,000
		Sligo Works,	10	Lyons, Short & Co.,	8,000
			20	Cuddy & Co.,	16,000
				Bissell & Co.,	20 000
				Smith, Boyer & Co.,	20,000
	Franklin Co.,			Hughes,	2,000
Maryland,	Ellicottsville,	Avalon,	24	Ellicotts,	28,000
	Gunpowder,		19	Pattersons,	5,000
		Ateatem,	13	J. McBrian,	2 000
	Elkton,			Whit'ker, Garret & Co.	15,000
Virginia ,	Richmond,	Belle Isle,	22	J. R. Triplett & Son.,	25,000
S. Carolina,				Nesbit, 2 factories,	
Ohio,	Cincinnati,				
				Kegs	1062 000

P. S.—This statement was made out from the quantities known to have come into market in certain years, with some exceptions, and may be considered at least 25 per cent. less on the average than was made from the above works. When fully employed, the yearly product may be taken fairly at 1,000 kegs for each machine per annum. In the West and at some of the interior factories, where the nails run fewer to the pound than at the North, the average would be nearer 1,100 kegs each machine. The quantities set down above, therefore, are about 25 to 30 per cent. less than the capacity of the Factories. A number of Works have been omitted for want of information. There are several on the Ohio river, about which nothing accurate is known. The make of last year (1845) is believed by well-informed dealers in New York to have been over 1,500,000.

The production of iron depending essentially upon the use of coal for smelting and elaborating it, renders "that good gift of nature" scarcely less important than iron, and hence closely connected with a proper consideration of the latter.

In relation to the coal trade, we are happy to avail ourselves, to some extent, of statistics recently published in the Miner's Journal of Pottsville, and which may be relied upon. That trade, it appears, suffered earlier than the iron trade, by the reduction of duties in 1838 and 1839, and was deeply affected at a time when the duty on foreign coal was much higher than that proposed by the bill now reported to Congress.

In 1838 the quantity of anthracite coal sent to market from all the regions of the State, was,—

	Tons.	Price at Phila.	Labor.	Foreign Coal Imported.
	723,836			129,083 T.
1839—	817,659			181,551 T.
1840—	865,414	$5·50	$5 to 6·00 per week	162,067 T.
1841—	956,566	5·00		155,394 T.
1842—	1,108,001	4·25		141,521 T.
1843—	1,263,539	3·50		41,163 T.
1844—	1,631,669	3·37	$8 to 10 per week	87,073 T.
1845—	2,021,674	3·50		85,776 T.

With this vast increase of the business, and advance of the wages of labor, being from 20 to 40 per cent.—yet it will be perceived that coal had been yearly reduced in price from 1842; and this arose from the confidence inspired by the bill of that year—attracting capital largely to the trade, by which all the improvements of the age were introduced, labor saving machines, &c., and by perfecting all the facilities of transportation, which latter will now compare with that of any other country in the world. But it may be asked, what can affect this trade? We answer, *Mines*—that challenge the competition of the world, both in abundance and quality—the Nova Scotia and New Brunswick coal fields, which, unlike ours, are accessible by water, and the coal of which may be transported at a small cost to every part of our Atlantic coast. Our coal fields, although unsurpassed in richness and extent, are in the interior of the country, and

although capital and enterprise has furnished us, as we have said, every facility of transportation to bring these vast and inexhaustible resources to our Atlantic border, yet the *transportation alone* is equal to the cost of the Nova Scotia coal, $1·50 per ton, delivered into the vessel—to which, if the duty of thirty per cent. be added, we have $1·95 as the cost—$1·55 less than the anthracite can be sold and delivered, at ship-board in Philadelphia; and we need not ask whether this would not prove ruinous to the trade, destructive to the wages of labor, and confer only a temporary advantage on the consumer. But let us see the investments in this trade, and whether it is worth preserving.

"This table," says the Miners' Journal, "was prepared with great care while Congress was deliberating upon the present Tariff bill, and showed the state of the trade previous to the passage of that bill.—At that time the investment of capital in the trade of Schuylkill county was estimated to be $17,526,000—it now reaches $26,856,000, showing an increase of *more than one half* within four years. It will also be observed by the statistics below, that the consumption of Produce and Merchandize has also nearly doubled within the same period.

But the most important bearing of the Tariff of 1842 on the coal trade of this county is yet to be noticed.

In 1837 the quantity of coal sent to market from Schuylkill county was	tons	540,000
In 1842 the trade had increased to only		572,000
Increase in a period of six years, only *thirty-two thousand tons.*		
In 1845 the quantity sent to market from this county reached	tons	1,132,000
In 1842		572,000
Increase in only *three years*	tons	560,000

It having nearly doubled within a period of three years, under the protective policy of the country; while, under the free trade, or low duty system, which existed from 1838 *to* 1843,* *a period of six years, the increase in the trade was only thirty-two thousand tons.*

Statistics of the Coal Trade of Schuylkill County.

Capital invested in 81 miles of Incorporated Railroads,	$1,000,000
do. do. 50 do. of Individual do.	150,000
do. do. 50 do. under ground do.	60,000
1500 Railroad Cars,	150,000
2400 Drift Cars,	96,000
34 Collieries below water level, with Steam Engines, Pumps, &c.,	850,000
100 Collieries above water level,	500,000
Landings,	200,000
Boats and Boat Horses,	500,000

* Although the present Tariff bill was passed and took effect on the first of July 1842, it did not create an increased demand for coal until 1843, though its effect on the trade was instantaneous in the confidence it invested to future operations.

Working Capital,	300,000
Schuylkill Canal,	5,000,000
Reading Railroad, Cars, Engines, &c.,	10,250,000
Towns in the Coal Region,	3,000,000
Danville and Pottsville Railroad,	800,000
80,000 Acres Coal Land at $50 per acre,	4,000,000
	$26,856,000
Estimated investment for same items in 1842,	17,526,000
Increase in 4 years with Protection,	$9,330,000

Tons of Coal sent to market in 1845,	1,131,724
Consumed in the region, about	75,000
Total tons,	1,206,724
Sent in 1841,	620,345
Increase—almost doubled in 4 years,	586,379

The population of the coal region of Schuylkill county is now almost 25,000. There are also about 2,000 horses used in the trade in the region.

Agricultural Products consumed in the Coal Region in 1845.

Wheat and Flour,	$187,000
Corn, Rye and Buckwheat,	180,000
Oats,	70,000
Hay,	80,000
Straw,	6,000
Beef and Pork,	260,000
Potatoes,	30,000
Poultry,	25,000
Butter,	23,000
Lard,	7,000
Milk,	35,000
Eggs,	8,000
Vegetables, Apples, Peaches, Turnips, Onions, &c.,	50,000
	$961,000
Consumption in 1841,	588,000
Increase in 4 years,	$373,000

Merchandize consumed in 1845.

Groceries,	$750,000
Dry Goods—foreign and domestic,	625,000
Boots and Shoes,	100,000
Drugs, Glass and Dye Stuffs, &c.,	40,000
Hats and Caps,	40,000

Saddlery, ...	15,000
Nails and Spikes, ...	20,000
Bar, Pig and Boiler Iron, ...	75,000
Railroad Iron, ...	50,000
Stone and Hollow ware, ...	10,000
Confectionery, ...	15,000
Jewelry, ...	8,000
Books, Stationery and Paper, . . .	10,000
	$1,758,000
Consumption in 1841, ...	918,000
Increase in 4 years, ...	$840,000

The quantity of Oil included in Groceries is a pretty considerable item. It is estimated that the quantity consumed in the region last year was worth at least *one hundred and sixty thousand dollars.*"

Can any mind contemplate the results of this vast industry—the labor employed—the capital expended—the railroads and canals which it sustains—the water powers and privileges which it has improved—the steam engines which it has put into motion—the furnaces, rolling mills, collieries and woollen establishments, which it has built up—the towns and villages which it has created—and be disposed to annihilate these great branches of national industry? If so, what will the laborers of the country say, for both iron and coal are the embodiment of labor? both are of little value, as we have before remarked, in the ground, but so necessary to the wants of civilized life as to have made England the mistress of the world, and all that world her debtors. They call more largely, and are more dependent, upon the other branches of industry for their support, than any other class of industrial pursuits. They have also arisen and flourished most where nature seemed to have doomed the country to everlasting sterility, and this fact brought from the good and great Wilberforce, in defending the iron interest in Parliament in 1797, the remark,—"That he had never felt a more sensible pleasure in his life than when, after the lapse of a few years, he had returned to a spot once rugged and barren, but then covered by the fruits of human industry, and gladdened by the face of man, in consequence of the introduction of this manufacture." Coal effects much, but nothing in comparison with iron. It is this manufacture that makes the wilderness blossom like the rose, and covers the barren hills not only with flowers, but also with flourishing villages. To illustrate this, we shall take the Schuylkill Coal Field, upon which there has been expended in railways, ca nals, &c., (all necessary for the iron business,) upwards of 26 millions, to bring to market 1,300,000 tons of coal, which is worth at Pottsville $2·00 per ton, or $2,600,000. The labor to mine and deliver this coal does not exceed 5,000 men. Now the single iron establishment of a private individual in England, Mr. Crawshay, employs 6,000 men, and manufactures upwards of 1500 tons of bar and railway iron per week; estimating this iron at the present prices of £10 0 or $50·00 (in England) per ton, we have a production or export trade

of $3,750,000—exceeding that of the entire coal trade by one million one hundred and fifty thousand dollars in money, and 1,000 more in laborers; and this establishment would eat up, annually, 375,000 tons of coal, 262,500 tons of ore, and 75,000 tons of limestone, and the English coal field is dotted over with such establishments; and all this population of laborers are consumers; and what must be the effect of these two trades upon agriculture, that *main* spring of national prosperity? Is it not too clear to admit of argument,—"That if the American farmer gives a product upon which he has employed a certain amount of labor and capital, to an American manufacturer in exchange for an American product, which has employed another equal amount of American labor and capital, the operation puts in motion *twice* as much *American* labor and capital as if he gave the same product to a foreign manufacturer, in exchange for a foreign product, which has employed an equal amount of foreign labor and capital?" This being admitted, and it being equally true, that *labor* is the wealth of a State and the source of all prosperity, and that the laborers of manufactures must be entirely consumers and not producers, is not the agriculturist directly benefited by this increase of the labor of the country, and just in proportion to the demand for it must the wages of labor be advanced, and the price of agricultural products be enhanced in value? Depress that labor and your consumption ceases, and it then matters not at what price you can buy. The great secret of prosperity is, that all classes of labor should be employed, and this can only be done by securing to ourselves our *Home Market* —this being protected from all ruinous foreign competition, "every citizen would be left at liberty to select that pursuit which he believed would most contribute to his happiness, and every branch of industry would naturally spring up upon the soil best adapted to it;" and, as we have a world within ourselves, and that very diversity of wants and productions which were intended by the God of nature to unite and bind us together, can we have any apprehensions that all the three great sources of national industry would not prosper—agriculture, commerce and manufactures? With regard to commerce we have only to look to our coasting trade, and compare it with the foreign. It is such a trade as no nation ever before enjoyed—the voyage of one of our rivers being almost equal to a trip across the Atlantic.

In conclusion, your committee regrets deeply that their limited time would not permit them to give to the subjects referred to them that consideration which they so eminently deserved, nor to present such precise and statistical information as the magnitude and importance of these great branches of domestic industry demanded; but from the defective nature of their estimates, they are not sorry to avail themselves of this occasion to earnestly press upon this Institution the necessity of preserving their organization, and using every effort to ascertain correctly the statistics in relation to these sources of our national industry. The Government, it is manifest, will do nothing towards organizing a bureau to collect facts and that description of information upon which sound legislation can only be based. It must

therefore be procured by the untiring industry of a few individuals, inspiring each other with the proper zeal and persevering in their laudable efforts. We fear that the make of iron has been over-estimated by relying upon official documents; but, if so, it is the duty of this Institution to have it corrected by the earliest day, and to furnish information from which correct conclusions may be drawn; all of which is respectfully submitted.

THOMAS CHAMBERS,
G. N. ECKERT,
SAMUEL J. REEVES, } Committee.

Dampness in Buildings: its causes and consequences, and the means of preventing it.

(Translated from the Magazin Pittoresque.)*

Dampness penetrates into the lowest floor of buildings either from the soil itself or by means of the foundation walls; it frequently arises also from rain beating on the surface of the exterior walls.

The influence of the different causes of dampness varies according to the nature of the soil or climate, the aspect in which the houses are built, the materials employed in their construction, and the different modes of construction. To get rid of humidity in the lowest story, it is ordinarily supposed, that all that is required is to elevate the foundations within the building above the level of the external soil; but if no other precautions were employed, this super-elevation would not diminish the dampness which rises from the earth itself, and that from the walls would be very imperfectly remedied, supposing the buildings constructed without cellars.

Among the numerous bad consequences of dampness we must reckon as the principal its unhealthiness, and its destructive effect on almost every thing subjected to its action; it causes plaster to fall, ceilings and floors to decay, paint to peel off, paper to become rotten: furniture, pictures and books are rapidly injured by it, and even the materials of the walls themselves undergo a gradual alteration which diminishes their solidity.

A constant moisture is not however necessarily destructive to buildings built of stone: stones laid in the ground, although constantly immersed in water, will remain uninjured; although this will not be the case where the stone is exposed by turns to dryness, moisture and frost.

It is a common expression, that damp always rises; and it might thence be supposed that moisture, in order to affect a hygrometric body, must come from below it, whereas in reality moisture is also diffused downwards, horizontally, and in every other direction. Now the materials ordinarily employed in building, wood, brick, rubble,

* This paper is an abstract of an Essay for which the first prize was awarded by the Society "D'Encouragement pour l'industrie nationale." The author of the prize essay is M. Vandoyer, government architect.

and stone of every kind, including even marble and granite, are more or less hygrometric; that is to say, if carefully weighed after having been immersed in water, are found to be heavier than they were when completely dry.* It is therefore clear, that the opposition which the nature of the materials offers to the progress of moisture is much less than is commonly supposed.

Inefficacy of the ordinary remedies.—Till lately attention has been confined to the means of remedying dampness in buildings after they have been constructed; precautions have seldom been taken to prevent it in the first instance. Recourse is generally had to cements, plasters and paint, applied to the interior surfaces of the walls so as to substitute by means of a body supposed to be impermeable, a dry surface for one more or less humid. Without desiring to analyse the qualities of the plasters usually employed, we do not hesitate to say that these various compositions, not only do not prevent, but do not even diminish, the real cause of the evil. The moisture which has penetrated through the walls is an agent of which the operation is continuous, and cannot be stopped. Its action cannot be diminished except by the action of air. The pretended *hydrofuge* cements merely disguise the evil for a certain period; they are even liable in many cases to the grave objection of diminishing the chances of absorption, and instead of helping to dry the building, tend to retain its moisture.

It is then the first cause of the evil which must be attacked. The only useful means are those which prevent the moisture from penetrating into the walls of the building, for when once it has entered them it is almost impossible to remove it.

Means of preventing dampness in the construction of buildings.—With respect to the dampness arising from the soil, the best means of preventing it is by interposing at a certain height some impermeable substance which will prevent the moisture passing beyond it. The only substances of this kind are lead, bituminous or resinous cements, and certain kinds of mortar.†

The interposition of a plate of lead or a layer of some bituminous substance in the thickness of the wall has been already tried with success, and is found to stop the progress of the moisture absorbed by the lower portion of the wall. This plate or layer should be a little above the internal level of the foundations.

This method, however, though efficacious in resisting the dampness arising from the ground, does not prevent the effects which the humidity of the atmosphere produces on the exterior surface of the walls in their lower part. In ordinary buildings we may point out as an excellent preservative against atmospheric moisture, a revêtement of flag stones placed against the external face of the wall, and

* From experiments made on the powers of absorption of different kinds of stone, it appears that a cubic metre of marble will hold 5¼ pints of water. A metre is 3 feet 3 inches.

† The nature of the mortars best adapted to resist moisture is explained in M. Vicat's work. See the C. E. and A. Journal for February last.

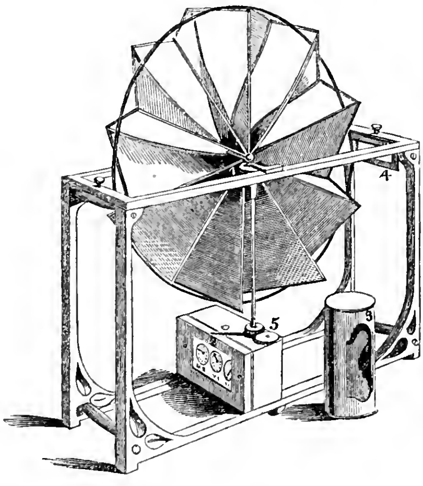
reaching to about a yard above the ground. If the foundations of the walls be of good limestone or grit-stone, this revêtement will not be necessary. It is well known that in the lower parts of walls to a certain height above the ground, the mortar of hydraulic lime should alone be used, and that when there are means of resting the foundations on an impermeable concrete, the best effects may be anticipated.

The precautions, then, to be taken against humidity in the walls are these—a foundation on hydraulic cement, the employment of hydraulic mortar in the lower parts of the building, the use of calcareous stones or revêtement built against the walls, and the interposition of an impermeable substance through the whole thickness of the walls between the exterior and interior levels of the soil.

Civ. Eng. & Arch. Jour.

Biram's Patent Anemometer, for Measuring the Velocity of the Wind, the Current of Air in Mines, &c.

The instrument consists of a wind wheel, having vanes or sails, so formed that the action of the wind upon every part of them tends to produce one revolution of the wheel in the same time that the wind travels two feet. On the axle of the wind wheel is a worm, or endless screw, in which works a wheel with 50 teeth (1,)—every revolution of which, therefore, indicates the passage of a current of 100 feet of



air. This toothed wheel is subdivided into 10 equal parts; so that an observer, noticing the number of revolutions and parts which it makes per minute, will have the velocity of the current in feet per minute at the time of observation. To facilitate the observation a minute glass (3) is sent with the instrument, which may be turned after the lapse of a few seconds, or as soon as the wheel has acquired an uniform velocity. By dividing the velocity in feet thus found by 88 (the $\frac{1}{60}$th part of a mile) it will give the velocity in English miles

per hour. For registering the current of air for a length of time, the instrument is mounted on a frame, and connected with wheel work by a rod at 5, which gives motion to three indices, revolving in three circles, marked respectively "Ms." "Xs. of Ms." and "Cs. of Ms." denoting thousands, tens of thousands, and hundreds of thousands—the index of the first-named circle making $\frac{1}{10}$th of a revolution for 1000, the next for 10, and the last for 100,000 feet of air passing through the wind-wheel. So often as 1,000,000 feet are indicated by the wheel, the indices will all stand at Zero, or X, upon the different circles; but it is not necessary that they should be so placed upon the anemometer, being first fixed in any situation, provided observation is made of the position of the three indices at the time. Upon making a second observation, notice the position of the three indices, (adding 10 to the number indicated by the Cs. of Ms. circle, if the index has in the interval passed X, or Zero,) deduct the amount of the first observation from the last, and the difference will be the number of feet of air which has passed through the wheel between the two observations. Mining Jour.

Manufacture of Cannon by Galvanic Process.

Letters from Berlin mention that the Baron de Hackewitz, who has an establishment there at which galvanoplastic processes are conducted on a large scale, has found the means of manufacturing guns and mortars of any calibre by that proceeding; and that a commission appointed by the Minister at War, with the Baron Alexandre de Humboldt at its head, to examine the invention, has made such a report as has induced the Government to purchase the secret,—which its author has valued at 36,000 thalers, (nearly 6,000*l.*)

Athenæum.

Errata.

Page 2d.—Lines 25—26, instead of "by the want of heavy plunges, &c." read, "by the heavy plunges and the want of active buoyancy."

Page 8th.—Line 4th from bottom: for "unavoidable," read "unavailable."

Page 11th.—Line 5th: before "dimensions" insert "usual."

Page 12th.—Line 16th from bottom: for "fig. 3," read "fig. 6." Line 5th from bottom, for "fixture," read "fixtures."

Page 15th.—Bottom line: for "98 lbs," read "128 lbs."

Page 16th.—Line 17th from bottom: for "cruisers," read "cruises."

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SEPTEMBER, 1846.

CIVIL ENGINEERING.

Extracts from the Report of Napoleon Garella, *an Engineer appointed by the French Government to survey the Isthmus of Panama. Transſlated for the Journal of the Franklin Institute by* Persifor Frazer, Esq.

(Continued from page 85.)

Port of the Canal on the Atlantic.—The bay of Limon, (also called by the Spaniards *Puerto de Navos,* the port of ships,) situated 8 kilometres (5 miles) to the north east of the mouth of the Chagres, is of great extent. Its entrance is 4,000 metres (4,375 yards) in width; its depth 6,000 metres (6,562 yards) in a north and south direction, and its mean width, which is pretty regular, 3,000 metres, (3,280 yards.) Its depth of water throughout is considerable, except at the head of the bay, which is entirely occupied by a flat covered with cocoa trees. In the middle of its entrance there are 11 metres (36·09 feet) of water; in the middle of the bay 7 to 8 (23 to 26 feet.) The bottom is mud and siliceous sand, offering an excellent holding ground for anchorage. All these advantages would make it an excellent port were it not directly exposed to the action of the north, north-east and north-west winds, which generally prevail in this portion of the Caribbean sea, and sometimes blow with great violence. The form of the coast, which runs off to the north-east, protects better the western shore of the bay than the opposite one. This shore has, moreover, a

greater depth of water. These circumstances have determined me to place the mouth of the canal about midway of the length of the bay, a little way inside of a small ravine, called *Caño de los Colorados.* To make an excellent port at this point, it will be sufficient to build a mole at the extremity of the promontory on the exterior of the ravine, and to carry it out for 1,000 metres (1,100 yards,) to a point where the depth of water is 9 metres (29·50 feet,)—more than sufficient for the largest vessels. The sheltered and protected space between the mole and the entrance of the canal, will have a superficies of about 5,000,000 square metres (6,000,000 square yards,) or 500 hectares (1,236 acres.) From the soundings made during my residence in the isthmus, in the month of February, 1844, by the officers of the French brig-of-war Le Papillon, Commander Sochet— which soundings agree with those made in 1829, by Mr. Lloyd—the depth of water is generally over 6 metres (19·68 feet;) in approaching the shore they found 5 and 4 metres (16·40 and 13·12 feet;) and close into the point of the *Caño de los Colorados*, 3 metres (9·84 feet.) There would, therefore, be but little to do, as may be seen, to attain a regular minimum depth, throughout this space of 7 metres (23 feet.) which is that of the canal, and thus to establish at this point a vast and sure port.

Port of the Canal on the Pacific.—The coast of the Pacific, on account, especially, of the great rise and fall of the tide, does not offer so advantageous a position as the bay of Limon for the creation of a good port. It has, however, one favorable circumstance, viz:—its situation at the bottom of the Gulf of Panama, which is a portion of that zone of the great ocean, from whence is derived the name of "the Pacific;" which situation, protected by the land, assures a still greater degree of tranquility to its waters. This circumstance, united to the vicinity of the islands of Taboga and Tabogicea, where there is a good port and excellent anchorage for the largest vessels, at a distance of only 12,000 metres (7·50 miles) from the little bay of Vaca di Monte, mentioned above as the point of embouchure of the canal, will dispense, at least for some time, with the necessity of any works for the protection of the entrance of the canal against the short and rare storms of this region. The canal debouching on the western side of the bay, which opens to the south-east, it will suffice to lower the bottom so that vessels may arrive at half-tide, which will allow of their entering and coming out during half of the day; for this a depth of 8 metres (26·24 feet) will be required, on account of the constant undulations of a sea subject to the action of the tide, and consequently 11 metres (36 feet) at high tide, when the sea attains the height of the last level of the canal. The island of Taboga will be the true port where ships will await the moment for entering the canal, and to which those having passed through it will repair. The little rivulet coming in at the head of the bay will be transformed into a reservoir, closing with sluice-gates, which, filling at high tide, will, by opening the sluices at low water, afford the means of constantly clearing out the bay, thus keeping open the entrance of the canal.

The little bay of Vaca di Monte has a width at its entrance of but 350 metres (382 yards,) and its shape is nearly semi-circular. Soundings

made on the 4th of July (two days after the high tide of the full moon of June 30th,) gave at low tide 3·50 metres (11·48 feet) of water in the middle of its entrance; 3 metres (9·80 feet) in almost all the other parts of the entrance; 2·70 metres (8·86 feet,) in the middle of the bay; and 3·50 metres to 4 metres (11½ to 13 feet) at about 100 metres (110 yards) from the shore. The tide of the 4th of July being estimated at a height of 4·80 metres (15·75 feet,) the preceding depths become at half-tide 5·90 and 5·40 metres (19·35 and 17·72 feet) at the entrance, 5·10 metres (16·73 feet) in the bay, and 6·40 metres (21 feet) at 100 metres outside; in supposing a slope of 0·005 metres to the bottom of the sea, we must go 620 metres (678 yards) from the shore to get a depth of 8 metres (26¼ feet) at half-tide, and it is thus far that the excavations must be advanced, and, consequently, for a total length of 800 metres (875 yards,) including the depth of the bay, and over a space of 280,000 square metres (334,883 square yards.) To render the entrance more sure and easy for vessels, to keep open in a more certain manner the pass thus excavated, and, above all, to assure the effect of the artificial current from the reservoir, and prevent its wasting its force outside of the pass, it will be indispensable to protect it by a jetty on each side projecting into the sea for at least 600 metres (656 yards.) By means of these works, it is certain that we may succeed in having at this embouchure of the canal, a sure port of easy access, except perhaps, during violent storms, which are of very rare occurrence in this part of the Southern ocean. But even this port may become insufficient, in case the number of vessels crossing the isthmus shall very considerably augment, in consequence of an unforeseen increase of foreign commerce. Commerce would then demand a port not at the distance of 11 kilometres (6·83 miles,) but at the entrance of the canal itself, accessible to the majority of vessels at all states of the tide. I do not pretend to give the complete plan of such a port,—a plan, the preparation of which would require for itself more time than all that which I passed on the isthmus. But it appears to me that this end might be attained by uniting the two moles lateral to the pass by a transverse jetty, in the middle of which could be placed a guard lock, thus transforming the entire pass and bay into a vast basin. A breakwater of from 800 to 1,000 metres (900 to 1,100 yards) in length, placed upon the lock at a point where there was at least 8 metres (26·25 feet) of water at the lowest tides, would serve to protect it against heavy seas, and would form at the same time an outer harbor, where vessels might always find shelter. I do no more than refer to these works, the construction of which, if necessary at all, will only be so at a very distant period, and whose dimensions and position can only be determined after long and careful study.

Summit-level with a Deep Cut.—I have already offered the plan of a canal, taking for granted the possibility of traversing the central chain by the aid of a subterranean passage, as this appears to me a preferable projection, inasmuch as it permits us to reduce the height of the summit-level. Nevertheless, lest my opinion should meet with opposition, I have equally studied the question, in the hypothesis, that the character of a great maritime canal, such as that of Panama, ex-

cludes all idea of a tunnel, and that the summit-level must be established only by the aid of a deep cut. The depth of cuttings hitherto executed on great public works does not exceed in general 25 to 30 metres (82 to 98 feet,) although there are particular instances in which this depth has been considerably surpassed. I have seen excavated, under my own eyes in a measure, a trench 2,000 metres (2,187 yards) long, 10 metres (32·81 feet) wide at the base, and 40 metres (131·23 feet) in maximum height, in the construction of the canal from Arles to Bone, not far from the point where it terminates at the port of Bone. It is known that the great trench of Huehueweo, made anciently for draining the lakes in the neighborhood of Mexico, which is 20,585 metres (12·80 miles) in length, has a maximum depth of 60 metres. Its depth, according to the work already quoted, of M. Chevalier, on a length of 3,500 metres, (3,827 yards,) varies from 30 to 50 metres (98 to 164 feet.) This is an extent, it is true, which is not reached in ordinary works, unless under circumstances of great necessity; but it appears to me, that for a work as extensive and important as a maritime canal across the isthmus of Panama, even more extensive undertakings would not be misplaced, and that to carry it out we would be justified in going beyond the limits within which such works have hitherto been confined. It is to be recollected, that the two trenches which I have just cited, were both of them dug in a soil unfavorable from its looseness and want of solidity, whilst that of the canal of Panama, on the contrary, will be excavated in a hard and very consistent crystaline rock, which will require nothing to sustain it. There should, therefore, be no difficulty in surpassing a little their depth. The limit which I propose for the depth below the highest point is 84 metres (275·60 feet,) which will place the bottom of the trench 56 metres (183·72 feet,) and the surface of the water 63 metres (206·69 feet) above high water. I see no impossibility in making a still deeper cut in ground such as that which forms the central chain, but the inclination of the talus tending to augment considerably, as we go deeper, the cubic feet of material to be excavated, and. consequently, the expense; this increase of expense, together with the difficulty of finding a place of deposit for the enormous quantity of stone taken out of such an excavation, interdicts our going any farther.

The ground is much more favorably shaped than that referred to in Mexico. The trench, with a depth of 84 metres, (275·60 feet) will be but 6,595 metres (4·098 miles) in length; nevertheless, in giving it the dimensions already fixed on, and an inclination of one-tenth to the lateral talus, the total of cubic metres of material to be excavated will be over 6,000,000 (about 8,000,000 cubic yards.) The dimensions spoken of are:—

Width at water line,	17·00 metres	(55·76 feet.)
" " bottom of canal,	15·60 "	(51·16 ")
" " level of tow-path,	21·20 "	(69·54 ")

At the height at which this trench will be placed, the rapidity of the descent on each slope of the ridge is such as to render absolutely necessary, sets of locks. On the Atlantic slope, the summit-level will be

immediately followed by a set of 5 chambers and 6 locks, by means of which, the canal will descend to level No. 1 of the first project, the length of which will be reduced to 500 metres (546·81 yards.) On the Pacific slope, the summit-level will be followed by two levels of 500 metres each (546·81 yards) after which will come a set of 5 united locks descending to level No. 2 of the first project, and reducing its length to 160 metres. To remedy the disadvantage of so reduced a length to this level, I propose a lateral dock, excavated in the bed of a rivulet on which this level is placed, which will have the double advantage of augmenting the proportion of the surface of the level to that of the locks, and, at the same time, affording a point of station for ships obliged to await the passage of other vessels through the united locks.

Chap. 7—*Supply of Water for the Canal.*

The consumption of water of a canal may be divided into two different classes, depending on distinct causes; those which act on particular points, and those which act on all points, indiscriminately and simultaneously.

In the first category are, 1st. The passage of vessels over the whole length of the canal, which occasions a loss of water at the summit-level. 2d. The movement of vessels passing in greater numbers to particular points of the canal without going entirely through it. 3rd. The loss of water by the passage of boats through levels whose lower lock is of greater lift than their upper one; and finally, filtration, produced by known causes, and to which remedies are applied either by puddling or by other means. This last cause cannot be calculated beforehand, for it is due to local circumstances, made apparent only at the moment of execution. In the canal of Panama, projected with uniform locks of an equal capacity, and through the whole length of which vessels are to pass, the losses of water coming under this first category are reduced to those occasioned by the passage of vessels across the summit-level, to which must be added the trifling loss by leakage at the gates, affecting only the summit-level, as each of the other levels receives from the one above it what it loses to the one below.

The causes of the loss of water to be included in the second category are,—1st. Evaporation. 2d. Infiltration, and sinking into the ground. 3rd. Mismanagement. The last is generally trifling, and may be almost entirely annulled by an active surveillance. I will, therefore, not take it into account.

The loss of water produced by the passage of a vessel through a lock is represented by a body of water of a surface equal to that of the lock, and a height equal to its lift. In the case before us, this volume of water would be 64 met. $\times$ 14·20 met. $\times$ 3 met. $=$ 2,726·400 cub. met. (96,260 cubic feet.) When a vessel passes through a level terminated by locks of an equal lift, the passage through the upper lock restores to the level the same quantity of water of which the passage through the lower lock has deprived it; but for the summit-level which is high-

er than each of its adjoining levels, the passage of the locks at its extremities, instead of compensating one for the other, add to the loss, which is the mean of the two locks. In this case, it will be 2,726·400 cubic met. × 2 = 5,452·800 cub. met. (192,520 cub. feet.) In supposing a mean daily circulation of ten ships of 500 tons each, corresponding to an annual tonnage of 1,800,000, the daily consumption of water for the passage of vessels will be 54,528 cubic metres (1,925,200 cub. feet.)

The loss of water occasioned by the leakage of the gates is ordinarily estimated at 300 cubic metres (10,595 cubic feet;) this amount is independent of the number of gates, as each level receives from the one above it what it loses to the one below; 600 cubic metres (21,190 cubic feet) will then represent the loss per diem due to this cause, but in consideration of the large dimensions of the gates, I will put it at 1,000 cubic metres (35,317 cubic feet.)

It is more difficult to estimate precisely the loss of water due to evaporation and filtration. Nevertheless, the result of observations, made with care, upon the Canal du Centre, which is cut through a clayey soil, similar to that along nearly the whole route of the Panama canal, permits me to arrive at a valuation sufficiently approximative. On the Canal du Centre, the loss due to infiltration is estimated at a body of water with a surface equal to that of the canal, and a thickness of 0·05 metres (1·97 inches;) that due to evaporation corresponds with a body of similar extent, and a thickness of 0·003 met. (·118 of an inch.) The first estimate may be admitted without augmentation, but the second must be augmented in the proportion that evaporation within the tropics has to that in France; this proportion, according to M. Humboldt, is as 16 to 10. I will suppose it still greater, and admit for the daily evaporation of the canal a body of water of 0·01 metres (·3039 of an inch) in thickness.

In adopting these bases, the surface of the summit-level being	7,730 met. × 17 met. =	131,410 sq. met.	
That of the Southern Branch,	13.450 " × 45 " =	605,250	"
That of the Northern Branch,	33,560 " × 45 " =	1,510.200	"
Making a total of		2,246,860	"

The loss by infiltration will be	2.246.860 sq. met. × ·05 =	112.343·000 cubic met.	
That by evaporation	2,246,860 " × ·01 =	22,468·600	"
Together,		134,811·600	"

The total loss of water of the canal in 24 hours may be estimated

For the passage of vessels,	54.528·000 cub. met.	(1,925,200 cub. ft.)
For leakage of gates,	1,000·000 "	(35,317 "
For filtration, evaporation, &c.	134,811·600 "	
Together,	190,339·600 "	

And, in adding about 10,000 cubic metres (353,170 cubic feet) for unforeseen losses. 200,000 cubic metres (7,063,400 cubic feet) corresponding to a regular supply of 2·32 cubic metres (81·94 cubic feet) per second, which may be easily supplied from the river Chagres.

At a gauging of this river, made at the period of its lowest water, March 26, 1844, at a point a little above Gorgona, situated 10·70 metres above high water of the Atlantic, and 4·90 metres above high water of the Pacific, the volume of water rolled per second was found to be 19·452 cubic metres.

Generally, in feeding canals, too much attention has been given to the loss of water occasioned by the passage of boats over the summit-level, a loss which is but a small portion of all that suffered by the canal, from the causes just enumerated. On this account, it is towards the summit-level that the supply of water destined to compensate the loss has been directed. This mode of alimentation has, for canals of a great length, serious disadvantages, due in a great measure to the length of time necessary for the water to pass from the summit-level to the two extreme points of the canal, and which are still greater in canals having short levels. These disadvantages have been particularly pointed out in an excellent memoir of M. Comoy, inserted in the Annals des Ponts et Chaussées, of 1831. It is therefore desirable to distribute the supplies of water along the whole length of the canal, and this arrangement renders the alimentation more easy, inasmuch as we are not obliged to seek the water at the height of the summit-level.

The southern branch of the canal (Pacific slope) has a length of but 13,450 metres. Its short levels are all in the upper portions, in the neighborhood of the summit-level. This last then may, without inconvenience, furnish it with all the water that it will need.

The northern branch (Atlantic slope) has not, properly speaking, any short levels. The shortest being 630 metres in length; but its length is considerable, as it extends to 33,560 metres, two and a half times that of the southern branch. There may, then, be some disadvantage in drawing from the summit-level all the water requisite for it. I will, therefore, propose to place a feeder in level No. 9, whose length is 15,150 metres, and in which the surface of the water is 21 metres above high water of the Pacific, and 26·80 métres above high water of the Atlantic. The distance of this level from the summit-level (the length of levels No. 1 to 8) is 5,920 metres. The length of the portion of the canal below it, including the level itself, is 27,640 metres. But by carrying a feeder into this level, and thus transforming it into a kind of reservoir, the length of the part, fed by a single feeder placed on one of its extremities, will be reduced to that of the lower levels, viz: 12,490 metres less than that of the southern branch. The situation of these two feeders being fixed, their capacity is easy to be determined. That of the summit-level must replace the water lost by the passage of vessels, by the leakage of the gates, and by infiltration and evaporation from the summit-level, and from a length of 13,450 metres + 5,920 metres = 19,370 metres. The feeder of level No. 9

must replace the water lost by filtration and evaporation over a length of 27,640 metres.

Feeder No. 1 should then furnish the following quantities:—

For the passage of vessels,	54,486 cub. met.		55,486·000 cub. met.
" leakage of gates,	1,000 "		
Surface of summit-level,		131,410 sq. met.	
" Southern branch,		605,250 "	
" upper part of Northern branch,		266,400 "	
Together,		1,003,060	
Multiplied by the depth of water lost by evaporation and infiltration,		0·06	60,183·600
Total,			115,669·600 cub. met.

Which corresponds to a regular and continued supply of a volume of water of 1·340 cubic met. per second.

The quantity of water which should be furnished by feeder No. 2 at level No. 9 is as follows:—

Surface of levels No. 9 to 17, 27,640 met. × 45 met. = sq. met.	1,243,800	74,628·000 cub. met.
Multiplied by the depth of water lost by evaporation and infiltration,	0·06	

Corresponding to a continued volume of 0·863 cub. met. per second.

Total of the supply of the two feeders, 190,297·600 cub. met.

The demand of the canal will then be completely supplied in introducing by feeder No. 1, 1·50 cub. met. per second, and by feeder No. 2, 1 cub. met. per second.

The dimensions of these feeders will be as follows:—

Feeder No. 1.—Depth of water,	1·20 met.
Width at bottom,	2·00 "
" at water level,	4·40 "

The inclination of the sides being 45°, and the longitudinal slope 0·0001 (1 metre in 10,000.)

Feeder No. 2,—Depth of water,	1·00 met.
Width at bottom,	1·90 "
" at water level,	3·90 "

The inclination of the sides and longitudinal slope being the same as in No. 1.

The source of water of both of these feeders, in the river Chagres, must be established at a height above the sea represented by the height of water in the level they are to feed, added to the ten-thousandth part of the length of the feeder.

From the leveling made by Mr. Lloyd, in 1829, which I have already had occasion to quote, it appears that the height of the river Chagres is—

At Gorgona,	10·64 met.	Above high water of the Atlantic.
At Cruces, 8,500 metres above Gorgona,	15·49 "	
At the point where the road from Porto Bello to Panama crosses, 31,955 metres above Cruces,	49·86 "	

The level of the water in the summit-level being 48 metres above high water of the Pacific, and 53·80 metres above high water of the Atlantic, the corresponding level in the Chagres will be 4 metres vertically above the point where the Porto Bello road crosses it. From the results of the leveling above mentioned, the fall between Gorgona and Cruces is 4·85 metres, or 0·00055 metre per metre. Between Cruces and the Porto Bello road, 34·37 metres, or 0·00107 metre per metre; as in all rivers the slope of the river augments as the distance from the mouth increases, we may admit, without fear of error, that the slope of the bed in the upper portion will be 0·0015 met. per met.; it will be, then, sufficient to ascend the river, to arrive at the level corresponding with those of the summit-level $\frac{4 \times 1,000}{1 \cdot 5} = 2,667$ metres. The point at which we would arrive would thus be 8,500 + 31,955 + 2,667 = 43,122 metres above Gorgona: the distance from Gorgona to the summit-level, in passing round the mountains, is 15,000 metres; the length of a horizontal feeder from the summit-level to the river Chagres would, then, be 58,000 metres, but having a slope of 0·0001 metre, representing a total fall of 5·30 metres, the source of water must be still higher up $\frac{5 \cdot 80 \times 1,000}{1 \cdot 5} = 3,867$ met. To resume, the feeder will have a length of 58,000 + 3,867, or about 62 kilometres; and the source of water must be established 47 kilometres above Gorgona, at a height of 5·80 metres + 53·80metres = 59·60 metres above the Atlantic.

We can hardly hope to find that at this height the river Chagres rolls as considerable a body of water as 19·453 cubic metres, that, found at Gorgona; the more so, as it has not yet received its principal affluent, the Pequeia, which descends from the mountains of Porto Bello. But as we have need of but 1·5 cub. met., it cannot be doubted that the river is able to furnish this quantity. It will be possible, moreover, to dam some of the water courses, tributaries of the Chagres that the feeder must cross, and to use their waters if it should be necessary to do so. At the point where the feeder intersects the brook of Báilamona, which is the last it crosses before arriving at the canal, there will be established, by means of a dam of no great extent, a reservoir, for the purpose of allowing the water to deposit the sediments it may have brought from the river in the rainy season.

As for the feeder No. 2, which is to supply level No. 9, the point where it reaches the level is 14,000 metres distant from Gorgona. The height of the level is 21 metres above the Pacific, and 26·80 metres above the Atlantic. The corresponding height in the Chagres is 11,300 metres above Couces, 19,800 metres above Gorgona, and 33,

800 metres above the junction of the feeder with the canal. The total fall of the feeder on this length will be 3·38 metres, corresponding with a length on the river Chagres of 3,200 metres, which is to be added to the precedent length to have that of the feeder, viz: 37,000 metres. Its source of water will be established 14,500 metres above Couces, and 30·20 above the level of the Atlantic. A reservoir for deposit will be established as for feeder No. 1, in a little brook which the feeder traverses a short distance before joining the canal.

By means of these two feeders, the alimentation of water of the canal will be liberally provided for. Nevertheless, it will be possible to unite still other resources: For example, that of a vast reservoir, formed by means of a dam, in the valleys opening into that of the Rio Paja, above the locks which terminate the summit-level. Thus, by forming in the Rio Lirio, about 1,000 metres (1,100 yards) above its junction with the Rio Paja, a dam of 20 metres in height and 1000 (1100 yards) in length, a reservoir may be formed with a superficies of 1,500,000 square metres, and capable of containing 15,000,000 cubic metres of water. In turning into this reservoir the waters of the upper portion of the basin of the Rio Paja, we may unite all that falling annually over a surface of 21,000,000 of sq. metres. It is known that the rains are much more abundant in southern countries, and especially between the tropics, than in the north of France. At Paris, the rain which falls is represented by a depth of 50 to 55 centimetres; between the tropics it is estimated at from 2·70 to 3 metres. Allowing at Panama the annual depth of 2·50 metres, a surface of 21,000,000 of square metres would receive 52,500,000 of cubic metres, a quantity much beyond what the reservoir spoken of would be able to contain. Such a reservoir would suffice for feeding the canal during 62 days in case either of the feeders should need reparation, or should have leaks which would not allow the arriving of the volume of water, which they are destined to furnish, at their extremities, this last case being very improbable. I do not, however, regard this reservoir as indispensable. I merely point it out as an accessory resource, the realization of which would be possible, if at a future period it should be judged necessary.

(To be continued.)

Extracts from the Reports of the Directors, and of the Engineer-in-Chief, of the Geo. R. R. and Banking Company, to the Stockholders in Convention, May 13th, 1846.

President's Report.

A statement of the Cashier, hereunto annexed, will show the financial condition of the Company, at the end of the last fiscal year: and the report of the Chief-Engineer, herewith presented, exhibits in a clear and satisfactory manner, the condition and management of the Road, up to the same period.

For obvious reasons, the operations of the Bank have been very

small during the past year. Though the institution possesses great strength from its valuable property in the Road, its banking capital is small, and the heavy and uncertain draughts upon it for the construction of the Road, have been inconsistent with an extended banking business. Besides furnishing, however, a depository for the safe-keeping and management of our finances, it is believed that this branch of the institution has, at least, paid the expenses of its management; and as the Road is now finished, and the cost of construction almost entirely liquidated, our banking operations may be considerably extended with safety and profit.

By the statement of the Engineer it will be seen that the nett profits

of the Road for the last year, are . .		$179,137·85
For the same time the interest paid, was	$56,763·56	
Reduced by interest, discount, &c., rec'd,	36,154·38	
Balance of interest,	20,619·18	
Add Bank Salaries, Taxes and Incidents,	10,155·22	30,774·40
Leaving Net, -		$148,363·45

Or about 6½ per cent. on the capital stock, after deducting interest and all other expenses, properly chargeable against both Bank and Road. As the crops of both cotton and provisions, in that part of Georgia on which our Road has heretofore mainly depended for support, have been uncommonly short,—and 42 miles of the Road were in use only half the year—this result is very favorable, and could only have been secured by the extension of the Road, which was completed in September last.

The bearings of trade and travel in reference to our improvement, have been fully discussed in previous reports, and are too well understood by the Stockholders to require further notice here. Though the Company has not the surplus means of its own, to embark further in Rail Road enterprise, the Stockholders feel a deep interest in the progress of such connecting improvements as must increase its business and enlarge the field of its operations. The State Road has already progressed to a point near the Ostenaula, and sufficient means have been provided by the State, to carry it to Cross Plains, without any unnecessary delay. The progress of this Road has already been marked by important changes in the business relations of the West, and when it reaches Cross Plains (fifteen miles from the Tennessee line,) a very large amount of trade and travel must leave their accustomed channels and turn to the South Atlantic coast. Should the State Road be completed to Chattanooga, and the recently chartered Road from that place to Nashville be built, the value of the business can scarcely be estimated, which would seek the shortest outlet through the ports of Georgia and Carolina.

The short but important branch from the State Road to Rome, has not progressed as anticipated in a former report. This is the more to be regretted, as an enterprising individual has, during the past winter, navigated the Coosa River, between Rome and the Ten Islands,

with entire success; and the completion of this short Road would divert the trade of the entire valley of the Coosa, and a large portion of North Alabama. The directors have understood that efforts are now making to revive the enterprise, and with strong hopes of success.

Important to our Road, as are the connecting improvements already named, those to the Southwest of our terminus, are perhaps equally so. Deeply impressed with the importance of an early completion of the Montgomery and West Point Rail Road, the Directors recently agreed to guarantee the bonds of that Company, for one hundred and twenty-five thousand dollars, to accomplish that desirable object. The Board was not unmindful that the credit of the Company should be pledged with great caution, for any purpose whatever. But, deeming the object very important, and the security against loss entirely ample, the guaranty was pledged on certain conditions, which, together with the measure itself, are respectfully submitted to the consideration of the convention.

The Directors are now enabled to congratulate the Stockholders on the final completion of their enterprise. A connexion with the State Road, at Atlanta, was made in September last, and a heavy and expensive increase in accommodations and outfit for an enlarged business, has also been made. Our investment will now assume more of a fixed and settled character. As the Road and outfit have cost about one million more than the capital stock, a debt for a part of that amount has been necessarily contracted. The finances of the Company have, however, been greatly simplified, and its liabilities are under easy control. A sinking fund from a portion of the nett profits, should be regularly applied to a reduction of the debt, whilst the convenience of many of the Stockholders will be best consulted by dividends of the remainder. This policy has been already indicated by the payment of $80,000 of the 8 per cent debt, during the past year, and a dividend of two dollars per share to the Stockholders in January last.

JNO. P. KING, President.

Engineer's Report.

ENGINEER DEPARTMENT, G. R. R. & B. Co.
Augusta, Ga., May 1st, 1846.

To the Honorable JNO. P. KING,
President of the Geo. R. R. & Bk'g Co.

Sir—I have the gratification to report to the Board, that the several lines of Road which the Company have contemplated building, are now in successful operation, embracing altogether 213 miles of railway, of which, there are 171 miles upon the main line between Augusta and Atlanta.

That portion of the Road unfinished at the date of my last annual report, was opened for use early in September, the period promised for its completion, at the commencement of the extension beyond Madison. The cost of the new Road, has fallen considerably within

the estimate submitted to the Stockholders before its extension was undertaken. Up to this period, the disbursements have been as follows:

Gradation, - - -		$262,801·82
Culverts, - -		14,930·73
BRIDGES.		
Alcovy River, 75 ft. high, and 1,400 ft. long,	$20,157·82	
Cornish Creek, 55 " " 720 "	5,818·79	
Wood's Mill, 65 " " 428 "	4,717·95	
Dried Indian, 44 " " 900 "	4,476·05	
Turkey Creek, 36 " " 360 "	1,686·47	
Yellow River 67 " " 485 "	11,532·02	
Sundry small Bridges, - -	2,241·27	50,630·37
Mud Sills, - -	20,548·81	
Cross Ties, - -	24.521·59	
Stringers, - -	28,102·91	
Iron, including duty, - -	271,548·43	
Iron Chairs, - -	11,646·74	
Spikes and Bolts, - -	15,232·59	
Laying Superstructure, -	32,697·79	404,298·86
Extension of Augusta Ware-house, and building offices, - -	3,830·65	
New Foundry and Stationary Engine House,	2,010·62	
Depots and Division Houses on Road,	3,270·84	
Engineering,	23,434·76	
Rod, Chain and Axemen,	2,092·20	
Wells, Pumps, Tanks, &c.,	2,045·98	
Right of Way,	18,810·48	
Real Estate,	11,365·81	
Miscellaneous Items,	3,128·78	69,990·12
Amount,		802,651·90
In addition to this sum I have advanced on sundry unsettled accounts,		7,332·33
Probable cost of unfinished work, consisting of covering and painting Bridges, Depots, Division Houses, extension of Turnouts, &c.,		10,000·00
Total cost of 68 miles of Road, including $105,000 paid for duty on Iron,		$819,984·23

The plan of superstructure adopted for the extension, is described in my annual report of May, 1844. From our experience thus far, we are satisfied that it is better adapted to Southern Rail Roads that have a considerable transportation, than any other. The iron rail is of the ∩ form, weighing 40 lbs, per yard, laid on a continuous bearing of pine timber.

We have also expended during the year, in the purchase of Locomotives, &c., and the construction of new Cars, necessary for the increased length of the Road, the following amounts.

For New Locomotives, Tenders, &c.,		$24,366.63
" 40 new Close Freight Cars,	$22,000·00	
" 10 Stock Cars,	4,750·00	
" 2 Large 8 wheel & one 4 wheel Pass'gr Cars,	5,080·00	
" 1 Long Baggage and Post-Office Car,	1,100·00	
	$32,930·00	
Less value of five Cars to replace two close and three open Cars, worn out, and charged to expense account,	2,450·00	
		30,480·00
		$54,846·63

To complete the outfit deemed necessary for the increased business expected next year, we have made arrangement for building

36 Close Freight Cars, which will cost	$21,000·00
17 Open " " " " "	9,000·00
2 Passenger and 1 Baggage Car, "	4,000·00
Total,	$34,000·00

These added to our present Stock, will make our complement 150 close freight and stock cars, 70 open cars, 10 passenger and 4 baggage cars.

Our motive power now consists of 6 Second Class Freight Engines with single drivers, 5 Freight Engines with 6 wheels all connected, and 4 Passenger Engines. Three additional Locomotives will also be required, one of which has already been ordered.

The Ware-House at Augusta has been extended 127 feet, and is now 288½ feet by 40. The offices have been removed from the main building and placed upon its side, giving additional room for Storage, which is now deemed sufficient for the wants of the Company for many years. A new brick Iron Foundry, 40 by 80 feet, has also been erected, and material alterations and additions made to the Shops. The erection of a larger Engine House, and more comfortable quarters for our Negroes, will constitute all the buildings that will be needed at Augusta. These, together with the removal of the Car Factory to the back part of the lot, will cost about eight thousand dollars.

From the annexed statement, (which includes the receipts for freight on the W. & A. R. Road) it will be seen, that notwithstanding a short crop of cotton in the region tributary to our Road, the operations of the year present results by no means discouraging.

BUSINESS.

Passengers up,		$ 47,129·12
do. down,		44,330·03
Extra Trips, Extra Baggage, &c.,		1,312·78
Negroes in lots,		870·50
Freight up,		114,938·09
do. down,		75,302·13
do. between way-stations,		4,858·34
United States Mails,		37,671·87
Rents,		417·65
Amount,		$326,831·51
Deduct amount paid to West. & Atlan. R. R. for freight due to that Road from the commencement of its operations, to April 1st, 1846		11,489·92
Leaving the business of the Georgia R. R.		$315,341·59

EXPENSES.

Conducting Transportation,	$31,353·53	
Motive Power,	36,406·46	
Maintenance of Way,	53,592·56	
Maintenance of Cars,	14,851·19	
		136,203·74
Leaving net profits,		$179,137·85

The customary statements exhibiting the receipts and expenses, in much detail, will be found among the accompanying papers.

The business of the Road exceeds that of last year, $43,592·07 of which $16,079·27 was received from passengers, $21,385·60 from freights, and $6,129·20 from mails, &c. The whole number of bales of cotton carried over the Road during the year, was 56,821, showing a decrease compared with the previous year, of 21,127 bales. The down freight has fallen off, however, but $14,819·56, owing to the transportation of other products than cotton, to a greater extent than usual.

The increased receipts of the Road, notwithstanding the reduced rate of our charges, and the deficiency in the crop, exhibit results that must be gratifying to every Stockholder, particularly to the advocates of its extension beyond Madison, by which alone, its prosperity has been preserved.

With an average crop of cotton, our business would have reached $350,000—the amount calculated as the probable receipts from the first year's business, after the completion of the whole Road—although the most important part of the work was not brought into use until the close of the first six months of the year.

The average number of passengers, carried both ways during the

year, per day, was nearly 66; of these, there was an average of 5 per day each way, entered through from Charleston to Montgomery.

The completion of the Western and Atlantic R. Road to Oothcaloga, has virtually extended our Road 80 miles beyond Atlanta, making the whole length of Road from Augusta, 251 miles,* which is nearly double the length of continuous line in use previous to September last. Under an agreement with the state of Georgia, our freight cars run through without transhipment. This arrangement enables us to carry freight at reduced rates, materially increases the usefulness of the Road, and extends the circle of its influence.

At Oothcaloga, we fairly enter the grain growing region, and our freight lists—which have heretofore been filled almost entirely with an enumeration of cotton bales,—now exhibit the same variety of the products of the soil and mines, usually noticed in the statements of Northern works penetrating agricultural and mineral districts. The amount of this description of freight, is yet small, but with the extension of the Road to the Tennessee River, it will become equal to, if not greater than is now transported upon any Rail Road connecting the Atlantic and Western States.

The easy access to the seaboard from Augusta, either at Charleston or Savannah, must, if sea-onable efforts are made on the part of her citizens, make her the great depot of these products, and consequently the point for exchanging them for merchandise for the consumption of the interior. The whole freight on agricultural products, from Chattanooga to Savannah, and to Charleston,—if the So. Carolina Company should reduce its charges,—will not exceed a half cent per lb.; a rate, which must divert from the Mississippi, the transportation of a vast region of country now tributary to New Orleans. It has been our practice heretofore, to place the rates of freight on these articles comparatively low, deeming it true policy to encourage this transportation, even at cost charges relying on receiving a return freight, from the proceeds of their sale, which would afford remunerating rates. I am fully satisfied that this policy should be continued.

The expenses of working the Road, include the transportation of about 3,000 tons of iron and other materials for the extension, an average distance of 150 miles, at an actual cost of about $5,000. If we deduct this sum from the expense account, ($136,203·74,) there will remain $131,203·74 as due to the regular business of the Road, which is equal to 41½ per cent. of the receipts.

The expenses per mile, run by the trains, for the past three years are as follows:

	1844.	1845.	1846.
Conducting Transportation,	17·50 cts.	16·50 cts.	13·9 cts.
Motive Power,	16·75 "	14·75 "	16·1 "
Maintenance of Cars,	6·75 "	8·25 "	6·6 "
Maintenance of Way,	25·00 "	23·00 "	23·7 "
Totals,	66·00	62·50	60·3

* Upon which the Maximum gradient does not exceed 37 feet per mile.

The number of passengers transported over the Road during the year, is equal to 2,183,645 carried one mile at a cost to the Company of 2·1-5th cents each.

The whole tonnage of the Road, exclusive of materials for repairs, and including iron and lumber for the extension, is equal to 3,440,000 tons carried one mile, costing an average of 2 cents per ton per mile. The regular business of the Road for the year, including the transportation of the Western and Atlantic Rail Road iron, is equal to 2,990,000 tons; which, if no charge is made for the transportation of materials for the extension and repairs, will give the cost per ton per mile, 2 3-10ths cents, or a little over one mill per 100 lbs. per mile.

The average cost of maintenance of way, per mile of Road, is $274·80, which includes relaying 4 miles of the Tilghman track, and provisions furnished Negroes laying iron on the extension. The cost next year will be somewhat increased, from the necessity of keeping the Road in more perfect adjustment, in consequence of the greater speed of the trains; it will not however reach $300 per mile.

This department has been placed under the immediate direction of Jas. H. Grant, as Resident Engineer, who was engaged for several years upon the construction of the Road. His long experience, professional skill, and great integrity of character, render him eminently qualified for the post he fills; and I feel entire confidence, that this branch of the service may be safely entrusted to his charge.

The transportation department, has, under all the circumstances, been conducted by Mr. Arms, in a manner very satisfactorily. With the exception of an interval of a few weeks, when the sudden increase in the length and business of th· Road, rendered it necessary to adopt a new system of running the freight trains, and add to the force several untried men, the trips have been performed with more than their usual regularity. The average speed of the passenger trains, was increased four miles per hour, which, for a time, caused some irregularity in their trips, and has rendered it necessary to incur heavier outlays on the repairs of the Road.

The lower 75 miles of our Road, it will be recollected, is laid with a plate rail 8-10ths by 2 4-10ths inches. Although this has been in constant use for nearly nine years, the iron does not seem to be greatly worn. A few bars have been broken at the spike holes, and others have failed from originally imperfect welding. Probably a half mile of new rails would replace all the defective bars. But as we shall require fully a mile of iron to increase the length of our turnouts, I would recommend the purchase of a small quantity of ∩ rail, and the removal of an equal quantity of plate rail—including the defective bars—to the turnouts.

The increase of our business, and the demand of the public for high speed, for which the plate rail is not well adapted, will, I am convinced, at no remote period, render it necessary to relay this part of the Road with a heavier rail throughout. This might be done, as far as the material would reach, by the erection of Furnaces and a Rolling Mill, with which to convert the present iron into a heavier rail—but

I apprehend that it will be found more economical to sell the present bar, and purchase the article desired.

In closing this report—the last annual communication that I shall probably make to the Company—I cannot refrain from expressing my sincere acknowledgments to the Board and Stockholders, for the uniform confidence that they have manifested, throughout our connexion, in my professional plans, and the management of the various interests of the Company committed to the discretion of this department.

The enterprise that we have been for many years so arduously engaged upon, has been brought into successful operation; and it gives me pleasure to add, that those shareholders who have patiently continued with us, to the final consummation of the object for which we have struggled, against adverse circumstances, have not only the gratification of being instrumental in scattering incalculable benefits through a vast region of country, but they have made an investment in a property which yields a fair return for their capital ventured in its construction.

All of which is respectfully submitted, by

Your Obedient Servant,

J. Edgar Thomson,
Ch'f Eng. & Gen'l Ag't.

Locomotives.

Numbers and Names of Engines.		Weight of each Engine, in tons and decimals.	Commencement of Service.	Number of miles run by each engine from Ap'l 1, 1845 to Ap'l 1, 1846.	Total number miles run by each engine from commencement of service to April 1, 1846.	Cost of repairs to each engine from April 1, 1845, to April 1, 1846.	Total cost of repairs and improvements to each engine from commencement of service to April 1, 1846.	Condition of Engines.	Remarks.
Pennsylvania,	1	11·40	May 5, 1837	24,336	188,731	$571·10	$5,404·42	In shop und'g'g repairs & altera.	
Georgia,	2	11·59	" "	27,127	121,197	1,315·91	6,706·85	In shop for repairs.	
Florida,	3	11·40	Dec. 27 "		60,581		3,526·74		Sold to the State of Georgia.
Alabama,	4	11·40	Jan. 12 1838	10,824	152,054	701·19	5,937·21		" " " "
Louisiana,	5	11·30	Feb. 2 "	33,585	163,275	626·58	6,828·38	On road in good order.	
Tennessee,	6	15·40	May 29 "	5,147	81,471	1,407·89	5,038·35	On road in complete order.	Altered to a 6 wheel connected engine.
Wm. Dearing,	7	13·00	Nov. 6 "	16,925	109,190	538·38	4,915·10	In house in good order.	
Virginia,	8	12·96	Dec. 24 "	6,021	77,928	490·61	5,260·25	" " "	
Mississippi,	9	13·00	" 28 "	17,618	78,025	488·99	4,131·76	On road in good order.	
Kentucky,	10	13·00	Mch 24 1839	18,602	90,843	610·41	4,879·63	On road in good order.	
Wm. Cumming,	11	12·35	Dec. 14 "	4,884	17,459	45·60	1,710·68	On road in complete order.	
James Camak,	12	12·35	" 23 "	5,073	46,038	226·50	2,888·11	In house in good order.	
Athenian,	13	11·08	Jan. 3 1845	15,635	19,745	697·14	718·14	On road in complete order.	B. & W.'s pat'nt 6 wheel connected eng. for Athens br'ch.
Cherokee,	14	15·40	Ap'l 28 "	11,118	11,118	306·86	306·86	In shop for renew. driv'g wheels.	B. & W.'s pat. 6 wheel do. do.
South Carolina,	15	15·68	Nov. 1 "	7,718	7,718	67·26	67·26	In house in good order.	" " " "
North Carolina,	16	15·43	" 4 "	7.558	7,558	52·55	52·55	On road in complete order.	" " " "
Eagle,	17	13·00	Dec. 5 "	13,680	13,680	368·10	368·10	On road in complete order.	
				225,851	1,246,611	$8,515·07	$58,770·39		

Elevation of the several Depots on the Georgia Railroad, and other important points, above the Atlantic.

		Feet.
Surface of rails at S. Carolina R. R. Pass. Depot, Hamburg,		152·00
Low water in Savannah river, or 0 of scale at Augusta bridge,		119·30
Surface of rails at	Augusta,	147·40
" "	Belair,	325·92
" "	Berzelia,	517·30
" "	Dearing,	489·30
" "	Thomson,	530·60
" "	Camak,	613·40
" "	Cumming,	647·20
" "	Crawfordville,	617·80
" "	Union Point,	673·55
" "	Woodville,	726·10
" "	Maxey's,	768·45
" "	Lexington,	788·10
" "	Athens,	712·90
" "	Greensboro,	626·80
" "	Buckhead,	641·50
" "	Madison,	695·91
" "	Rutledge,	728·56
" "	Social Circle,	890·30
" "	Covington,	762·88
" "	Conyers,'	909·00
" "	Lithonia,	954·00
" "	Stone Mountain,	1,054·78
" "	Decatur,	1,048·80
" "	Atlanta,	1,050·13
" "	Marietta,	1,132·60

Low water in	Oconee	river, at	Athens,	614·90
"	"	"	Junction of Apalachee,	426·30
"	Alcovy	"	R. R. Bridge,	659·30
"	Yellow	"	" " (in dam,)	638·30
"	Chattahoochee	"	" "	762·45
"	Etowah*	"	" "	696·45
"	Oostenaula,	"	" "	623·45

Highest point on Athens Branch 108½ miles from Augusta,	821·30
Highest point on extension of road west of Stone Mountain,	1,088·30
Surface of rails at Kennesaw Summit, near Marietta,	1,156·32
" " in Tunnel,	859·15
" Ridge above Tunnel,	1,034·15
Low water in Tennessee river at Chattanooga,	642·55

* Elevation of 0 of West. and At. Railroad Levels.

Distances on the Georgia Railroad between Augusta and Atlanta, from station to station, in miles and decimals.

	Belair.	Berzelia.	Dearing.	Thomson	C'mak	Cumming.	Craw f'dv'le	Union Point.	Greensboro.	Buckhead.	Madison.	Rutledge.	Social Circle.	Covington.	Conyer's.	Lithonia.	S one Mount	Decatur	Atlanta.
Augusta,	10·100	20·845	28·956	37·530	46·930	56·853	64·391	76·000	83·197	95·659	103·310	112·192	119·389	129·919	140·347	146·723	155·200	164·641	170·701
Belair,		10·745	18·856	27·430	36·830	46·753	54·291	65·900	73·097	85·559	93.210	102·092	109·289	119·819	130·247	136·623	145·100	154·541	160·601
Berzelia,			8·111	16·685	26·085	36·008	43·546	55·155	62·352	74·814	82·465	91·347	98·544	109·074	119·502	125·878	134·355	143·796	149·856
Dearing,				8·574	17.974	27·897	35·435	47·044	54·241	66·703	74·354	83·236	90·433	100·963	111·391	117·767	126·244	135·685	141·745
Thomson,					9·400	19·323	26·861	38·470	45·667	58·129	65·780	74·662	81·859	92·389	102·817	109·193	117·670	127·111	133·171
Camak,						9·923	17·461	29·070	36·267	48·729	56·380	65·262	72·459	82·989	93·417	99·793	108·270	117·711	123·771
Cumming,							7·538	19·147	26·314	38·806	46·457	55·339	62·536	73 066	83·494	89·870	98·347	107·788	113·848
Crawfordville,								11·609	18·806	31·268	38·919	47·801	54·998	65·528	75·956	82·332	90·809	100·250	106·310
Union Point,									7·197	19.659	27·310	36·192	43·389	53·919	64·347	70·723	79·200	88·641	94·701
Greensboro,										12·462	20·113	28·995	36·192	46·722	57·150	63·526	72·003	81·444	87·504
Buckhead,											7·651	16·533	23·730	34·260	44·688	51·064	59·541	68·982	75·042
Madison,												8·882	16·079	26·609	37·037	43·413	51·890	61·331	67·391
Rutledge,													7·197	17·727	28·155	34·531	43·008	52·449	58·509
Social Circle.														10·530	20·958	27·334	35·811	45·252	51·312
Covington,															10·428	16·804	25·281	34·722	40·782
Conyers',																6·376	14·853	24·294	30·354
Lithonia,																	8·477	17·918	23·978
Stone Mountain,																		9·441	15·501
Decatur.																			6·060

	Woodville.	Maxey's.	Lexington.	Athens.
Union Point,	4·75	12·30	22·10	38·40
Woodville,		7·55	17·35	33·65
Maxey's,			9·80	26·10
Lexington,				16·30
Athens,				

From Camak to Warrenton, 3·75 miles.

Note.—Having discovered some typographical errors in the table of distances from which the foregoing was taken, we have endeavored to correct them.—*Com. Pub.*

Statement of the Condition of the Georgia Railroad and Banking Co., on Monday morning, April 6, 1846.

ASSETS.			
The Road and its outfit,	$2,386,989·89		
Extension of Road beyond Madison,	811,206·85		
Materials for Road,	26,267·71		
J. E. Thomson, Chief Eng. and Gen. Agent, extension account,	48,212·30		$3,272,676·75
Salaries, Incidental Charges and Protests,	10,452·22		
Interest account,	27,648·42		
Road expenses,	139,599·42		177,700·06
Real Estate for Road,	47,606·67		
Banking house and lot,	32,184·49		
Negroes,	49,573·00	129,364·16	
Balances due by Agents,	8,110·41		
Due by the State of Georgia,	70,537·85		
Assets taken in compromise,	64·63		
Stocks in other Institutions,	16,790·00	95,502·89	
Discounted notes,	130,806·60		
Discounted bills,	32,150·06		
Bills receivable,	25,824·05	188,780·71	413,647·76
Notes of Suspended Banks (value.)	148·10		
Notes of Banks in other States,	8,851·50		
City of Augusta and Savannah change bills,	57·18	9,956·78	
Due by banks in New York, Philadelphia, Charleston, Savannah and Athens,	29,359·35		
Notes of specie-paying banks in Georgia,	44,241·50		
Gold and silver coin in vaults of the bank,	49,535·00	123,135·85	132,192·63
Total Assets,			$3,996,217·20
LIABILITIES.			
Capital Stock,			$2,289,284·92
Collections on Personal Account.	27,318·04		
Collections in Newton County Stock,	4,101·09		
Bills payable, and permanent deposit,	14,690·00	46,109·13	
Income from Railroad,	321,058·10		
Discount, premium and rent accounts,	7,029·24		
Profit and loss,	204,596·08	532,683·42	578,792·55
Deposits on long time,	139,000·00		
Deposits on interest,	125,363·13		
Company's bonds,	574,900·00		
Dividends unpaid,	11,234·78	850,497·91	
Due to banks and corporations,	1,514·44		
Due to Agents,	1,019·83		
Due Chief Engineer of the State of Georgia	400·78		
Due to depositors,	52,952·57	55.887·62	906,385·53
Bank notes issued,	1,439,195·00		
Railroad receipts issued,	28,755·50	1,467,950·50	
Bank notes and Railroad receipts on hand,		1,246,196·30	
Bk. notes and R. R. receipts in circulation,			221,754·20
Total Liabilities,			$3,996,217·20

Remarks on Iron Rails for Railways. By R. Ritchie, C. E.

Mr. Barlow came to the conclusion that the strength of a bar should be double that of the mean strain or load. In his first report, he thought from 10 to 20 per cent would be sufficient; that is, for a 12-ton engine, as the weight is at present distributed, a strength of 7 tons would be ample provision; and with greater accuracy of construction, a less strength would suffice; or rather, allowing the same strength, an engine of 14 or 16 tons might be passed over with greater confidence. Thus, for 12 tons' weight, with a velocity of about 35 miles per hour, 7 tons would allow a surplus strength of 16 per cent. beyond double the mean strain. The deductions from his experiments led him to recommend that the section of an iron rail for a 5-feet bearing, with strength 7 tons, should not exceed 5 inches in depth; that the head ought not to be less than 2·25 lbs. per yard, and be 1 inch in depth; that the whole weight at the sections should be 67·4 lbs. per yard; the thickness of the middle rib, ·85 inch; depth of bottom web, 1·66 inch; and breadth of ditto, $1\frac{1}{8}$ inch; that the deflection of such a rail with 3 tons, would be ·064 inch.

For bearings of less width, he did not reduce the weight or size of the head, but kept it at the same section, decreasing the whole weight and depth of the rail: thus, for a weight of 7 tons, with a 3-feet bearing, the whole weight was 51·4 lbs., the whole depth $4\frac{1}{2}$ inches, depth of bottom web 1 inch, breadth 1·25 inch, thickness of middle rib ·6 inch, deflection with 3 tons was ·024 inch.

Notwithstanding that Professor Barlow expressed a strong opinion in favor of the single-flanched rail over the double,—that he could see no advantage the latter possessed to compensate for its actual and obvious defects, that he considered it inferior in strength and convenience in fixing, and that the advantage it was supposed to possess, namely, that it might be turned when the upper table was worn down, was impracticable, and that he saw no advantage in the broad bearing,—still the double-headed rail, in practice, has almost entirely superseded the single one: whether the adoption of the double one arises from affording greater convenience to the rail layer, and facilities for keying it, and the advantage of having the power of reversing it, and selecting the best side, or from the manifest advantage of a broad bearing to the rail,—this form is now generally preferred.

The Liverpool and Manchester Railway Company has of recent years adopted a double parallel rail of a peculiar section; not admitting, however, of the power of turning it. The object to be attained in adopting this shape, is stated to be, that by having the part of the rail upon which the flanch of the wheel acts, of the same outline as the flanch itself, greater strength is given to the rail, while the other edge of the rail is lightened. These rails have been laid down at 60 and 75 lbs. per yard.

The more common and useful form of a double parallel rail, is when the segmental outline is the same at top and bottom; for although it cannot be denied that the weight of the bottom flanch does not add

proportionably to the strength of the rail, nor even that the power of turning it is at all times practicable,—yet there cannot be any doubt that this form, for railways constructed on separate blocks and sleepers, presents many advantages; and besides, as the cost is nearly the same for a rail with the top and bottom flanches alike, with that where the bottom web is somewhat lighter, no hesitation can exist in preferring the former, however much theoretical deductions may mystify the subject.

A double parallel rail weighing 75 lbs. per yard, has been laid down on the London and Birmingham, Eastern Counties, South Eastern, Edinburgh and Glasgow, and many other railways. The whole depth is 5 inches, the top and base are the same sections, 2·5 inches, the thickness of middle rib is about ·75 of an inch, or less.

A double parallel rail has been used upon the Grand Junction and other railways, weighing 62 lbs. per yard; whole depth, 4·5 inches.

A double parallel rail, about 65 lbs. per yard, of which the whole depth is about 4·5 inches, has been laid down on some parts of the London and Birmingham railway.

A 75 lb. rail was laid down on the Edinburgh and Glasgow railway. The inner side of the chair being curved, admits of ample space for the key to wedge the rail firmly.

The rail and chair which are now laying down on the North British railway are about 70 lbs. per yard, in 12 and 16 feet lengths. The top and base are different sections, probably adopted with a view of saving in the weight, but presenting no corresponding advantages. The keys or wedges are made of oak, and are small in size.

It seems generally agreed, that the bearing surface for the wheels to run upon, without being too heavy, or so narrow as in an additional degree to wear the wheels, should be about 2½ inches; and hence this size of a head is generally adopted for public railways. Although, both theoretically and practically, it has been assumed, by Messrs. N. Wood, Barlow, and E. Wood, that the strongest form of rail is that of which, with sufficient depth for rigidity, the base does not contain too great a quantity of material,—and though Mr. Barlow has given a formula for calculating the section of greatest strength,—still the great object that the public are interested in, is the best form of rail for safety; and of which, while it has sufficient strength to bear upon it heavy loads in motion. the bearers should not be too far apart, to increase in the least degree the amount of either vertical or lateral deflection. When a rail possesses these advantages, its exact shape on mathematical principles is of less importance than its convenience of being easily fixed, and quickly shifted. Hence, while the single parallel rail is decreasing in practical application, the double one, from its convenience, is progressively extending. A knowledge of these facts is essentially necessary for every one engaged or connected with railways, whether he be a director or shareholder, whether an engineer or manager. With all the knowledge yet acquired, there is ample evidence of the uncertainty which still hangs around the subject: and the great expense it has already cost some of the older companies in making alterations, shows that experience to them has been

dearly bought. For example, it has been shown that the Liverpool and Manchester Railway Company has had several times to alter the rails on that line; to increase the weight from 35 lbs., the weight of the original rail, to 50 lbs., 65 lbs., and 75 lbs., per yard, successively; while the London and Birmingham Railway Company, notwithstanding the advantages derived from Mr. Barlow's able report, was obliged to reduce the width of the bearings or supports from 5 feet to 3 feet 9 inches, and to increase the weight of the rails from 64 lbs. to 75 lbs. On other railways equally expensive alterations have been made. There is every probability, therefore, that, so long as that plan of railway construction continues, whatever may be the first cost to railway companies, a still greater weight must be given to the rails, and a still farther reduction of the width of the bearers must take place, in order to adapt the stability to increased rapidity of traction.

It may be observed that the rails have gradually been increased in strength since steam power was introduced; the bars are usually made in 12, 15, and 16 feet lengths, with square or butt ends, and are laid end to end, the earlier complex contrivances to secure the joints being all dispensed with, and the half-lap joints now rarely used. About $\frac{1}{16}$ of an inch, at least, should be left between the ends for expansion; for it has been ascertained that a bar of 15 feet in length will expand about $\frac{1}{11}$ of an inch at 75° F. Some have, indeed, proposed to place a small piece of wood between the ends of rails, as the different expanding properties of wood and iron would fill the space, the wood expanding as the iron contracts; but such a plan is liable to objection from the wood being likely to be shaken out, and the space being left vacant. There is no part of railway construction that requires more accuracy of fitting than the joints: the squareness of the ends, and the space allowed for expansion, cannot be too carefully regulated. Instead of that, how often are seen spaces at the joints of different widths, and the ends of the bars in juxtaposition, without parallelism and uniformity of level; thus increasing the amount of friction, adding to the jolting and rocking motion, and to the risk of the wheels of carriages being thrown off the rails. Civ. Eng. & Arc. Jour.

MECHANICS, PHYSICS, AND CHEMISTRY.

Report of Trial of the Revenue Steamers "Spencer" and "McLane."

By Alex. V. Fraser, Capt. U. S. Rev. Marine.

With two Copper-plates.

To the Hon. Robert J. Walker,

Secretary of the Treasury.

Sir: In obedience to your order of the 7th ultimo, directing me to make a trial of the relative speed of the iron revenue steamers Spencer and McLane, in the waters of Long Island Sound, I repaired to New York on the 11th and obtained an interview with Commodore Perry, who (with the Engineer-in-chief of the Navy, Mr. Haswell,

and the principal Engineer, Mr. Copeland,) had been directed by the honorable Secretary of the Navy to attend and witness the experiments, agreeably to the invitation of this department. Arrangements were likewise made that Captain Loper, proprietor of the Propeller, and Messrs. Lighthall and Coney, engineers, should be present.

Mr. Copeland being absent from the city, and not having received his orders, the trial was deferred two days in anticipation of his return.

On the 13th, Mr. Copeland, not having returned, I proceeded with the other gentlemen to New London, and was engaged during the 14th in making the requisite preliminary arrangements. Great care was taken to trim both vessels as much alike as possible. The coal to be used was the best quality, anthracite, from the same mines, (Beaver Meadow.)

Taking into consideration the very defective model of these vessels, and that the engines were constructed for, and particularly adapted to, Hunter's submerged wheel, rendering it necessary to use cog wheel gearing, no proper estimate of the speed attainable by the side wheel or propeller, can be arrived at. Still their relative value in speed and consumption of fuel may be very satisfactorily determined. It must be borne in mind that the diameter of the propeller, and consequently its effective power, is limited by the draft of water, in order to keep it entirely submerged, and at the same time above the line of the keel, while the diameter of the side wheel may be increased by raising the shaft, thereby increasing the speed.

In the McLane, however, the diameter of the wheels is as great as desirable for sea service.

Both vessels, as exhibited in the annexed drawings, (plates 1 and 2) are precisely similar in model and dimensions, and each is furnished with two high-pressure horizontal engines: diameter of cylinder 24, and length of stroke 36 inches.

A sketch of the half cross section of the vessels is hereunto appended, (plate 3 fig. 2) which will clearly exhibit to practical men, that speed under steam, or stability under canvas, are unattainable objects. Plans of the propellers and mode of gearing, are likewise given.

Each vessel is furnished with a single boiler, having 1450 feet fire surface. The Spencer is furnished with two of Loper's propellers, one projecting from each quarter, and the McLane with side wheels, having 14 buckets each. All the dimensions of the propellers and wheels are hereafter given, and the draft of water, dip of buckets, &c. are exhibited in tabular form, with each day's trial. The buckets of the side wheels were, at the suggestion of Messrs. Haswell and Coney, moved eight inches towards the centre, before making the trial on the last day.

The Spencer is furnished with three masts, and the McLane with two. The resistance offered however, by the spars when steaming head to, or before the wind, is the same in both vessels, as the yards are carried on the foremasts only, and the dimensions are the same on board of each.

Commodore Perry informed me, that the engineers and himself had

been instructed by the honorable Secretary of the Navy, merely to witness the experiments, and take notes of the proceedings.

Feeling desirous myself, that every opportunity should be afforded to a fair and strictly impartial investigation of the subject, I stated to those gentlemen, that as the experiments were deemed of great importance, not only to the Government, but to the commercial community, and that as this was the first opportunity which had ever offered in this country to test the relative value of the side wheel and propeller, on board of vessels similar in model of hull, description of machinery, power, &c., I should solicit, and expect to receive the benefit of their experience and advice, while conducting the experiments, giving them the assurance that all their suggestions should be carried into execution.

It will be perceived by reference to the drawings, (plates 2 and 3,) that the relative revolutions of the engines and wheels of the McLane, are as 1 of the former to ·6528, while the relative revolutions of the engines and propellers of the Spencer are as 1 to 1·25. The greatest care was exercised in weighing the coal. and the pressure of steam, revolutions, times, &c., were carefully noted every fifteen minutes.

The distances, set, and velocity of the tides, are given upon the authority of the superintendent of the coast survey, and the time of slack water, noted in each day's work.

The Engineer-in-chief of the Navy, having been present by direction of the Secretary, it is presumed that a report embracing all the elements and results of the trial will be made by him. Making no pretensions to a scientific acquaintance with the subject myself, I have consequently confined my report to a simple statement of facts and have given, in tabular form, the points passed, times, distances, revolutions of engines, and of wheels, consumption of fuel, tides, &c., as data, from which persons interested in the subject may make their own calculations, and determine the results.

The trial on the first day, from New London to Falkner's Island, and returning, was under, as nearly as possible, a uniform pressure of steam, and the safety valve was loaded with 45 pounds to the square inch. On the second day, the trial was made by confining the number of revolutions of the engines as nearly as possible to thirty-five, and returning under twenty-two and one-half lbs. pressure of steam.

On the third day, as before mentioned, the buckets of the side wheels were moved eight inches towards the centre, increasing the revolutions under the same pressure, in order to ascertain whether the increased speed attained was commensurate with the increased consumption of fuel, and at the same time to ascertain what distance each vessel could be propelled with 2,000 pounds of coal. This portion of the trial was quite interesting. The second propeller of the Spencer did not stop until the steam gauge exhibited a pressure of but two pounds.

On the first day a strong gale prevailed from the westward, with a turbulent head sea, reducing all the sailing vessels in sight which were working to windward to double reefs, and the great differences ex-

hibited in consumption of fuel, and speed, between the passage from, and returning to, the light boat, were doubtless produced by the resistance offered by the wheel-houses of the McLane, when steaming head to the wind, and the assistance afforded when before it, as well as the inefficient operation of wheels of so small diameter in a sea way, while the propeller being submerged was exercising the same effort at all times, and under all circumstances.

A trial of the sailing qualities was not deemed important, for experience had hitherto shown that, by the wind, this model has neither speed nor stability.

I have the honor to be very respectfully, your ob't servant,

ALEX. V. FRASER,
Capt. U. S. Rev. Marine.

TREASURY DEPARTMENT, May 12, 1846.

OFFICE OF THE COAST SURVEY,
Washington, April 30, 1846.

Capt. A. V. FRASER, Revenue Bureau.

SIR:—I have the honor to transmit a table of distances as required by the letter of the Secretary of the Treasury, of April 28, stated in nautical miles according to the tenor of the letter:—

	Nautical miles.
Central wharf, New London, to $\frac{1}{8}$ mile east of Fort Trumbull,	$\frac{1}{2}$
$\frac{1}{8}$ mile east of Fort Trumbull to $\frac{1}{4}$ mile east of New London light-house,	$1\frac{5}{8}$
$\frac{1}{4}$ mile east of New London light-house, round Goshen reef to light-boat on Bartlett's reef,	$3\frac{1}{2}$
$\frac{1}{4}$ mile east of New London light-house close south of buoy to light-boat on Bartlett's reef,	$3\frac{1}{4}$
From light-boat to range of Saybrook light-house and beacon on bar, and 3 miles distant from light-house,	$7\frac{1}{8}$
From last point to another where Killingsworth Church bears N. E. $\frac{1}{2}$ N., distant 4 miles,	$12\frac{2}{3}$
From same point to another, Falkner's Island bearing west, and Killingsworth Church bearing north by east,	11
From light-boat on Bartlett's reef to Falkner's Island light,	$24\frac{1}{8}$

Average velocity of flood and ebb between New London and light boat,	2 miles per hour.		
Do. do. Light-boat and Saybrook bar,	2	"	"
Do. do. Saybrook bar and Falkner's Island,	2	"	"

Yours respectfully, A. D. BACHE,
Sup't Coast Survey.

Journal of the U. S. Revenue Steamer Spencer.—First day, April 15, 1846.—From New London light-house to Falkner's Island; (Distance 27·62 miles;) keeping up, as much as possible, a uniform pressure of steam. Cutting off at half stroke, and throttle wide open. Draft of water aft 9 feet 10½ inches. Forward 9 feet 5½ inches. Safety valve loaded at 45 lbs.

Times.	Points Passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of Steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel.	Remarks.
h. m. s												
9 31 00	N. Lond. Lt. N.W.	s by E.	N. W.	Strong gales—vessels in sight—under double reefs.	Turbulent head sea.	Advrs.	Average two nautical miles per hour	43	46	Average revolutions, 280 per minute.	In raising steam, 1816 lbs.—Consump. from 9h 21m. a.m. to 1h 52m. p.m., 7380 lb.—1634 lb. p. hr.	At 9h. 21m. A. M. started abreast, Fort Trumbull N. W., distant one mile.
48 00								43	45			
57 00	Light boat.							43	44			
10 15 00		W.S.W.				Fair.		41	43			
30 00								45	44			
45 00								45	43			
11 00 00								44	43			Speed by log 6 knots.
11 00	Saybrook light.							44	43			
15 00								45	43			
30 00		W. by S						42	3			
45 00								42	3[illegible]			
12 00 00								45	43			Speed by log 6 knots.
15 00								42	3[illegible]			
30 00		W.	N.W. by W					43	40			
45 00								43	40			
1 00 00								38	37			On this day the cut-off on 1 engine did not operate effectually.
15 00			W. N.W.					40	3[illegible]			
30 00								40	37			
45 00								39	36			
52 00	Falkner's Island light.					Slack.		39	36			
								846	816	Average revolution of propellers 51. 00.		
						Means		42·30	40·80			

Returning from Falkner's Island Light house to N. London Light-house.—Conditions as above.

Times.	Points Passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of Steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel.	Remarks.
h. m. s.												
4 26 00	Falkner's Island light	E.	N.W. by W	Strong gales	Abeam. | Sea running on quarter.	Fair.	Average 2 nautical miles per hour.	40	43	Average revolutions, 250 per minute.	Coal consum'd from 4h. 26m to 7h. 59m. 4100lbs, or 1155 lbs per hour.	At 4h. 26m. P. M started abreast of the McLane. Falkner's Island light-house N W. ½ W., distant 1 mile.
45 00								45	44			
5 00 00								40	43			
15 00								44	46			
30 00								43	41			
45 00								43	44			
6 00 00								44	44			
15 00	Saybrook light.							46	48			
30 00								42	43			
45 00								41	42			On this day the cut off on one engine did not operate effectually.
7 00 00								40	40			
15 00								45	43			
23 00	Light boat.							45	43			
30 00		N. E. N.				Advrs.		44	44			
45 00								40	37			
59 00	N. London light.							40	37			
								652	685	Average revolution of propellers 53·51.		
						Means		42·62	42·81			

Journal of the U. S. Revenue Steamer Spencer.—Second day, April 16, 1846.—From New London to Saybrook light-house; (Distance 10·83 miles;) limiting the revolutions of the engines to 35 per minute. Cutting off at half stroke. Draft aft 9 feet 8 inches. Draft forward 9 feet 3 inches.

Times.	Points Passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of Steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel.	Remarks.
h. m. s.												
11 53 00	N. Lond. Lt.	W.	Light southerly airs.		Perfectly smooth.	Advrs.	Av. 2 nautical miles p. hr.	48	35	Average, 200 per min.	Fr'm 11h.37m. to 1h.39m 726 lbs., or 357 lbs. p. hr.	At 11h. 37m. A. M. started abreast of the McLane. Fort Trumbull W. distant quarter of a mile.
12 00 00								46	35			
15 00								44	36			
32 00	Light-boat.							35	34			
45 00						Fair.		35	35			
1 00 00								35	35			
15 00								34	35			
39 00	Saybrook lt.					Slack.		35	35			
								312	280	Average revolution of propellers 43.75.		
						Means		39	35			

During the above trial confined the number of revolutions of the engine by throttling of the steam. Throttle from one-fourth to three-eighths open,

Noted the time when Saybrook light-house and the Round Shoal Beacon were in range.

Returning from Saybrook light-house to New London; (Distance 12·46 miles;) limiting the pressure of steam to $22\frac{1}{2}$ pounds. Throttle full open, and cutting off at half stroke.

Times.	Points Passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of Steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel.	Remarks.
h. m. s.												
2 17 00	Saybrook lt.	E.	Southerly.	Very light.	Perfectly smooth.	Fair.	Av. 2 nautical miles per hour.	22 50	31·00		From 2h. 57m. to 4h. 45m. 1452 lbs., or 588·07 lbs. per hour.	At 2h. 17m. P. M. Saybrook light-house and the Round Shoal beacon in range. started abreast.
30 00								22 50	31·00			
45 00								22 50	31 50			
3 00 00								22 50	32 00			
15 00								22·00	32 00			
30 00								22·50	32 50			
46 00	Light boat.							22·50	32·00			
4 00 00		N. E.				Advrs.		22·50	32 50			
15 00								22·50	32·00			
24 00	N. Lond. lt.	N.										
30 00								22·50	32 00			
45 00	Ft. Trumbull							22·50	32·00			
								247	351	Average revolution of propellers 39·88.		
						Means		22·54	31·91			

Journal of the U. S. Revenue Steamer Spencer.—Third day, April 17, 1846.—On this trial raised the steam to 45 lbs. pressure, then filled the furnaces and weighed out 2,000 lbs. of coal, with a view to ascertain the distance each vessel would be propelled with that amount of fuel. Draft of water aft 9 feet $6\frac{1}{2}$ inches. Draft forward 9 feet 3 inches. (Distance run 23·95 miles.)

Times.	Points Passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of Steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel	Remarks.
h. m. s.												
9 10 00	N. London.	s.	South-westerly.	Very light.	Perfectly smooth.	Slack.	Av. 2 nautical miles per hour.	Average 35—4 lbs.	Average 36—8.	Average 280.	2,000 lbs.	
16 00	Ft Trumbull					Advrs.						
59 00	Light-boat.	s.s.w.										
10 54 00	Saybrook lt.	w.				Fair.						
11 15 00												Coal all in the furnaces—open throttle, & took off cut-offs.
12 04 00												
22 00												Larboard engine stopped.
56 00												Starboard engine stopped. Pressure by mercury gauge 2 lbs.
										Average revolution of propellers 46.		

When the second engine stopped, Killingsworth Church bore N. by E., and Falkner's Island west. The McLane astern—when the wheels of that vessel stopped, the angle measured between her mast-head and lower part of white streak, 3° 20′ 15″. Height of mast 89 feet, consequently the Spencer 1,529 feet ahead.

Returning to New London light, started with Killingsworth Church bearing N.E. ½ N. 4 miles distant, with 45 lbs. steam. Furnaces full, and McLane one length ahead. (Distance run 20 miles.)

Times.	Points Passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of Steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel	Remarks.
h. m s												
2 42 00		Westerly.	Perfectly calm.		Smooth.	Slack	Av. 2 nautical miles per hour.	45	42	Average 300.	From 2h. 42m. to 5h. 27m., 2,541 lbs. or 921·6 lbs. per hour.	
45 00						Advrs.		41	44			
3 00 00								45	46			
15 00								45	46			
30 00								45	46			
45 00						Fair.		44	45			
4 00 00								44	46			
15 00								48	48			
30 00	Saybrook lt							44	44			Started.
45 00								45	45			
5 00 00								45	45			
15 00								45	44			
27 00	Light-boat.							45	45			
								581	586			
						Means.		44·69	45·07	Average revolution of propellers 56·33·		

ALEXANDER V. FRASER,
Capt. U. S. Revenue Marine.

I certify that the above steam journal is correct.
JACOB F. WILSON, *Chief Engineer U. S. Rev. Marine.*

Journal of the U. S. Revenue Steamer McLane.—First day, April 15, 1846.—From New London light-house to Falkner's Island light-house; keeping up, as much as possible, a uniform pressure of steam. Cutting off at half stroke. Throttle full open. Draft aft 9 feet 11 inches. Safety valve loaded at 45 lbs. Draft forward 9 feet 6 inches—side wheels. Diameter 16 feet 5 inches. 14 buckets. Face 5, 11 X 10 inches. Dip of buckets 3. 10. (Distance run 27·62 miles.)

Times.	Points Passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of Steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel.	Remarks.
h. m. s.												
9 32 15	N. Lond. Lt.	S. by E.	N. W.	Strong gales, vessels in sight, under double reefs.	Turbulent head sea.	Advrs.	Average 2 nautical miles per hour.	38	24 00	Average revolutions 529.	In raising steam, 1960 lbs. Consumed from 9h. 21m. a.m. to 4h. 3m. p.m. 6221 41 lbs., or 928 57 lbs. per hour.	9h. 21m. A.M. started abreast, Fort Trumbull N. W. distant one mile.
45 00								42	25 00			
10 00 00								45	26·00			
06 40	Light-boat.					Fair.		45	25 00			
15 00		W. S. W.						45	25 00			
30 00								45	25 00			
45 00								45	25 00			
11 15 00								45	24 00			
30 00		W. by S.						45	24·00			The McLane constantly blowing off steam, caused by the vessel pitching.
45 00								45	25 00			
12 00 00								45	24 00			
15 00								47	24 00			
30 00		W.	N. W. by W					45	23 00			
45 00								45	24 00			
1 00 00								45	24 00			
15 00			W. N. W.					45	24 00			
30 00								45	24 00			
45 00								45	24·00			
2 00 00						Slack.		45	24·00			
15 00						Advrs.		45	24·00			
30 00								45	25 00			
45 00								45	24 50			
3 00 00								45	24 00			
15 00								45	23 00			
30 00								45	24·50			
45 00								45	24·00			
4 00 00								45	25·00			
03 30	Falkner's Island lt.							45	25·00			Av. revolution of wheels 15·90
								1250	682			
						Means		44 64	24·36			

Returning from Falkner's Island light-house to N. London light-house.

Times.	Points Passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of Steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel.	Remarks.
h. m. s.	Falkner's											
4 26 00	Island lt.	E.	N. W. by W	Strong gales	Abeam | Sea running on the quarter	Fair.	Average 2 nautical miles per hour.	37	26	Average revolutions, 592.	Coal consumed from 4h. 26m to 8h. 23m 4,650 lbs., or 1181·43 lbs. per hour.	Vessels abreast of each other at 4h. 26m. Falkner's Island li't-house N. W. ½ W., one mile.
30 00								40	27			
45 00								40	28			
5 00 00								45	29			
15 00								45	28			
30 00								45	29			
45 00								45	29			
6 00 00								45	28			
12 00	Saybrook lt.							45	28			
30 00	house.							45	29			
45 00								45	28			
7 00 00								45	28			
15 00								45	28			
30 00								45	28			
42 00	Light-ship.							41	27			
8 00 00		N. E.				Advrs.		40	26			
20 00		N.						38	25			
23 00	N. Lond. Lt.											
								731	471			
						Means		43	27·12			Av. revolution of wheels, 17·70.

Journal of U. S. Revenue Steamer McLane.—Second day, April 16, 1846.—From New London to Saybrook light-house, (Distance 10.83 miles,) limiting the revolutions of the engines to 35 per minute. Cutting off at half stroke. Draft aft 9 feet 9 inches. Forward 9 feet 3 inches. Dip of buckets 3. $9\frac{1}{2}$.

Times.	Points Passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel.	Remarks.
h. m. s												
11 37 00	Ft. Trumbull	W.	Light southerly airs.		Perfectly smooth.	Advrs.	Av. 2 nautical miles p. hr	45	29·00	Average revolutions, 656,	Coal consum. in raising steam 1800 lbs. Fr'm 11h 37m. A.M. to 1h. 26m. 30s. P. M., 1800 lbs., or 990·82 lbs. per hour.	At 11h. 37m. A. M. started abreast of the Spencer. Ft. Trumbull west distant ¼ mile.
45 00								42	28·50			
53 00	N. Lond. lt.							45	28 00			
12 00 00								45	28 00			
15 00								48	31 00			
28 40	Light-boat,							48	29·00			
45 00						Fair.		48	29 00			
1 00 00								51	32·00			
15 00								48	32·00			
26 30	Saybrook lt					Slack.		48	30·00			
								468	296			
						Means		46·80	29·60			Av. revolution of wheels 19·32

Noted the time when Saybrook light-house and the beacon on the bar were in range.

Returning from Saybrook light-house to New London, (Distance 10·83 miles,) limiting the pressure of steam to $22\frac{1}{2}$ pounds. Throttle full open, and cutting off at half ftroke.

Times.	Points Passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel.	Remarks.
h. m. s												
2 17 00	Saybrook light-house.	E.	Southerly.	Very light.	Perfectly smooth.	Fair.	Av. 2 nautical miles per hour.	22·50	20·00	Average, 223.	Coal consumed from 2h. 17m to 4h 27m. 30s. 375 lbs., or 173 08 lbs. per hour.	At 2h. 17m. P. M., started abreast, Saybrook light-house and the Round Shoal beacon in range.
30 00								22·50	20·00			
45 00								21 00	20·50			
3 00 00								20 00	20 00			
15 00								22·50	20·00			
30 00								22·50	22 00			
47 40	Light-boat.							23·00	22 00			
4 00 00		N. E.				Advrs.		22·50	22·00			
15 00								22·50	22·00			
27 30	N. Lond. lt.							22 00	22·00			
								221	210			
						Means		22·10	21·00			Av. revolution of wheels 13·71.

Journal of U. S. Revenue Steamer McLane.—Third day, April 17, 1846.—On this trial raised the steam to 45 lbs. pressure, then filled the furnaces and weighed out 2.000 lbs. of coal, with a view to ascertain the distance each vessel would be propelled with that amount of fuel. Draft of water aft 9 feet 7½ inches. Draft forward 9 feet 6 inches. Dip of buckets 3 feet—at the suggestion of Engineer Haswell, the buckets had been moved in 8 inches. (Distance run 23·66 miles.)

Times.	Points passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of Steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel	Remarks.
h. m. s												
9 10 00	N. London.	s.	South-westerly wind, very light.		Perfectly smooth.	Slack.	Average 2 nautical miles per hour.	40	28 50	Average revolutions 307.	2,000 lbs.	At 9h. 10m. A. M. started from N. London.
19 00	Ft. Trumbull					Advrs		40	25 50			
30 00		s. s. w.						43	27·00			
36 00	N. Lond. lt.							45	28 00			
45 00								43	35 00			
10 00 00								42	33 00			When the wheels stopped steamer Spencer 1529 ft. ahead—equal to ·29 of a mile, which is deducted from the distance.
04 20	Light-boat.	w.						45	35 50			
15 00								45	35 00			
30 00								45	38 00			
45 00								45	38·00			
11 01 00	Saybrook lt.					Fair.		45	35·00			
15 00								43	28·00			
30 00								40	27·00			
45 00								—	24 00			
12 00 00								—	20 00			
15 00								—	18·00			
30 00								—	9			
39 00	Wheels stopped.							9	—			
								570	493			Av. revolution of wheels 18·93.
						Means		40·71	29·00			

Returning to New London light, starting with Killingsworth Church bearing N.E. ½ N., 4 miles distant, with 45 lbs. steam. Furnaces full, and Spencer one length astern. (Distance run 20 miles.)

Times.	Points passed.	Course.	Winds.	Strength.	Sea.	Tide.	Velocity.	Pressure of Steam.	Revolution of engines.	Revolution of blowers.	Consumption of fuel	Remarks.
h. m. s.												
2 42 00		Westerly.	Perfectly calm.		Smooth	Slack.	Average, 2 nautical miles per hour.	45	34 00	Av. revolutions, 691.	Consump of coal from 2h 42m. to 5h. 30m. 3 500 lbs., or 1 250 lbs. per hour.	At 2h. 42m. P. M. started.
45 00						Advrs.		45	37 00			
3 00 00								46	39 00			
15 00								46	40·00			
30 00								47	40 00			
45 00						Fair.		47	40 50			
4 00 00								48	42 00			
15 00								48	42·00			
22 30								47	40 00			
30 00								47	40·00			
45 00								46	39·00			
5 00 00								46	39·00			
15 00								47	40·00			
30 11	Light-boat.							46	39·00			
								651	551			Av. revolution of wheel 25·49.
						Means		46·50	39·36			

W. A. HOWARD,
Capt. U. S. Revenue Marine.

I certify that the above steam journal is correct.

JAMES WRIGHT,
Chief Engineer U. S. Revenue Marine.

Having thus presented all the data connected with these experiments, I have, with permission, appended the reports of Commodore Perry and the Engineer-in-chief, Mr. Haswell, with the calculations made and the deductions drawn from said data by the last named gentleman.

I have the honor to be, very respectfully,
Your obedient servant,
ALEXANDER V. FRASER,
Captain U. S. Revenue Marine.

Hon. R. J. WALKER,
Secretary of the Treasury.

WASHINGTON, May 18th, 1846.

Sir:—In the execution of instructions contained in your letters of the 6th ultimo, the undersigned proceeded to New London, Conn., for the purpose of witnessing some experiments that were to be made by order of the Treasury Department, with the Revenue Steamers "Spencer" and "McLane," the former fitted with two of Loper's propellers, (screw,) the latter with the ordinary side wheels.

Upon our arrival at that place, we were met by Capt. A. V. Fraser, temporarily in command of the "Spencer," under whose directions the experiments were to be made—and also by Capt. Wm. A. Howard, in command of the "McLane," who, in conjunction with the former, afforded us every practicable facility in the prosecution of the object of our attendance.

The necessary preliminary arrangements being made, and the two vessels having been brought to a similar draft of water, and provided with similar fuel, (anthracite,) it was decided that the trials made should be to determine the following points:

1. The relative speed of the vessels, and consumption of fuel, with equal pressures of steam, when running under various circumstances of wind and weather.
2. The same points as above, the engines of the "Spencer" being reduced in speed to assimilate, as far as practicable in power, to those of the "McLane."
3. The same points, with the pressures of steam reduced one-half.
4. The effect of the consumption of an equal quantity of fuel (2,000 lbs.) with similar initial pressures.

The elements for a comparison of the two vessels, regarding their form, &c., are as follows:—

Their hulls, engines and boilers, were constructed from duplicate drawings. One vessel had three, and the other two masts, adapted for equal surfaces of canvas. This difference of rig, however, could not in the least have influenced the results of the trials; and especially so, as the vessels were not tried under canvas. The instruments of cutting off the steam differed in some degree, that of the "Spencer" being a slide valve, and that of the "McLane" a puppet. In the spaces between the grate-bars, there was also a variance, those of the "Spencer" being the greatest, and consequently effecting a greater

waste of fuel. The gearing of the engines, propellers and wheels, was similar in its character, (cogged wheels,) the only mechanical difference, being that necessarily due to the peculiar means of propulsion.

The bottoms of the vessels, and the engines and boilers, were, as far as our observation extended, aided with the information received respecting them, in equally good order.

Respecting the proportions of the different propellers, it was clearly shown that they were of sufficient diameter and surface for the purpose intended. There was a point, however, connected with their application, which in our opinion materially interfered with the speeds of the vessels, arising from the relative speeds of the engines, and each of their attached propellers. Had the engines been geared so as to have worked faster with equal pressures, there would have been a material increase of power, (as the boilers of the vessels were capable of supplying a greater quantity of steam than that they were restricted to in these trials.) Had this disadvantage been similar, it would alone have effected the rate of speed; but as it occurred, the engines of the "McLane" were geared so as to preclude the attainment of a power with similar pressure equal to that of the "Spencer." The effect of this, however, is duly considered in determining the results given in statement C, which was prepared by Charles H. Haswell; as a substitute for which, M. C. Perry submits statement D; while to those marked A and B, we refer you for details of the information on various points indicated in your letters.

Very respectfully, your obedient servants,

M. C. Perry,

Chas. H. Haswell,
Eng'r-in-Chief U. S. N.

Commodore Charles Morris,
Chief of Bureau of Construction, &c., Washington, D. C.

[A.]

Dimensions of Vessels, Engines, Propellers, &c., &c.

Vessels.—(Iron.)

Length between perpendiculars,	143 feet.
Beam at knuckle,	$18\frac{1}{2}$ "
Beam at water line,	22 "
Depth of Hold,	11 " 10 in.
Displacement at load line,	460 tons.
Area of *immersed section,*	166 feet.

Engines.

Two, non-condensing.
Cylinders, 24 inches diameter, by 3 feet stroke of piston.
Steam, *cut* off at half stroke.
One *boiler*, containing 1,450 square feet of heating surface.
Combustion—Anthracite coal aided with a blast.

Power.

The horses power of the engines is estimated by the formula.

$\frac{S \times (P - f + 14 \cdot 7)}{33{,}000}$ where S represents velocity of piston in feet per minute. P, mean effective pressure upon cylinder piston in pounds, per square inch; and *f*, the friction of the engines, equal $\frac{1}{8}$ of pressure upon steam gauge.

"Spencer."

Two *screw propellers*, 8 feet in diameter, having four blades each, with an area of $11\frac{1}{2}$ square feet on each side.

Angle of blades at hub, from plane of axis, 30°—at edge of blade, 54°.

Revolutions of propellers, $1\frac{1}{4}$ for each revolution of engines.

Draft of water, 9 feet 8 inches.

"McLane."

Two *side wheels*, 16 feet 5 inches in diameter in trials 1, 2, 3 and 4, and 15 feet 1 inch in trials 5 and 6; 14 buckets in each wheel, 10 inches by 5 feet 11 inches each.

Immersed area of buckets in each wheel. 24 square feet.

Revolutions of wheels, 65 for each 100 of engines.

Draft of water, 9 feet $8\frac{1}{2}$ inches.

[B.]

Elements of Comparison of the various Trials.

The distances given are in nautical miles, and were furnished from the office of the U. S. Coast survey, from bearings taken of several points.

Trials 1 *and* 2.

Speed and *consumption of fuel*, with *equal pressures*, and under various circumstances of *wind* and *weather*.

Run.—From New London harbor to Falkner's Island light, and back to New London light.

Wind and Weather.—Wind N. W. by W.

Out.—Strong gales, with a turbulent head sea.

In.—Fresh gales with a turbulent sea.

	OUT.		IN.	
	Spencer.	*McLane.*	*Spencer.*	*McLane.*
Average* pressure of steam in pounds. per square inch.	42·3	47·	42·	45·
Average revolutions of engines per minute,	41·5	24·5	42·	28·
Time of running, in hours and minutes,	4h.31	6h.42	3h.32	3h.57
Distance run through the water in miles, the effect of the tide† (2 knots) being estimated,	24·25	27·75	22·85	22·4
Speed in miles per hour,	5·4	4·14	6·48	5·67
Consumption of fuel in pounds per hour.	1224	928	880	1176
Power of engines in horses,	186	129	192	147

* In these trials the cut off of the starboard engine of the Spencer was not used, the effect of which, however, is estimated. and the consumption of fuel given is in accordance with it.

† Estimate from the office of the Coast survey.

Trials 3 *and* 4.

Out.—Speed and consumption of fuel, the pressure of steam in the "Spencer" being reduced, in order to assimilate the power of the engines to those of the "McLane."

In.—Speed and consumption of fuel, the pressure of steam in both vessels being equally reduced to 22·5 lbs. per square inch.

Run.—From New London light to a point off Saybrook light, and back to place of starting.

Wind and Weather.—Light airs from the south with smooth sea.

Steam.—The throttles of the "Spencer's" engines were occasionally closed, to reduce the revolutions in the run *out.* The effect of this is fully estimated, as the revolutions of the engines of this vessel were ascertained at such pressures as were necessary to determine it.

	OUT.		IN.	
	Spencer.	*McLane.*	*Spencer.*	*McLane.*
Average pressure of steam per square inch, in pounds,	39·	47·	23·	22·5
Average revolutions of engines per minute,	35·	29·6	32·5	22·
Time of running, in hours and minutes,	1h.46	1h.31	2h.7	2h.10
Distance run through the water, in miles,	11·25	10·33	9·8	9·4
Speed, in miles, per hour,	6·36	6·78	4·62	4·34
Consumption of fuel, in pounds, per hour,	360	990	588	172
Power of engines, in horses,	150	155	76	52

Trials 5 *and* 6.*

Out.—Speed and duration of operation with similar quantities of fuel—2,000 pounds of coal being allowed to each vessel.

In.—Speed and consumption of fuel under equal pressures and various circumstances of wind and weather.

Run.—From New London to a point off Saybrook light, when the engines of each vessel stopped for want of fuel. Returning, from off Falkner's Island to the light-boat on Bartlett's reef.

Wind and Weather.—Light breezes from the S. W. and smooth sea.

	OUT.		IN.	
	Spencer.	*McLane.*	*Spencer.*	*McLane.*
Average pressure of steam, in pounds, per square inch,	Valve loaded at 45 lbs.		44·	48·
Average revolutions of engines per minute,	—	—	45·	40·
Time of running, in hours and minutes,	¶ 3h.46	¶ 3h.29	2h.45	2h.48
Distance run through the water, in miles,	23·	22·7	19·8	19·8
Speed, in miles, per hour,	—	—	7·2	7·07
Consumption of fuel, in pounds, per hour,	†	‡	925	1250
Power of engines, in horses.	—	—	220	216

* In these trials the wheels of the "McLane" were reduced in diameter 16 inches.

¶ In this trial, the distances run and the times of running (equal distances) were very nearly alike, the difference being inappreciable. One of the engines of the "Spencer" continued working for several minutes after all the others had stopped, which increased the time of running of that vessel beyond the other.

† While coal lasted 950 lbs.

‡ While coal lasted 850 lbs.

[C.]

Results of the Comparisons deduced from the preceding Elements.

In these, the consumption of fuel is not considered, for reasons which will appear obvious when presented.

1. The boilers and engines being identical in capacities, the amount of steam used in the engines is an exact measure of the expenditure of each means of propulsion, which amount is estimated in the calculations of power here given.

2. The steam required was so much below the actual capacities of the boilers to furnish it, and so nearly alike in its quantities, that a hurried combustion of the fuel was unnecessary. Hence the waste consequent upon rapid combustion was not only not incurred in either vessel, but was not incurred by either means of propulsion at the risk of its economy compared with the other.

3. The omission of this element sets aside the effects of the difference in the grate-bars, and of any difference in firing by different individuals.

The computation, then, of the powers of the engines, is considered a fair and proper exponent of the cost of propulsion; while the cubes of the speeds are taken as the measures of the effects produced, which elements, (those of power and effect) being reduced for each trial, the following deductions are furnished:

1.

Spencer. Power, $186 = 1{\cdot}00$ effect $5{\cdot}4^3 = 2{\cdot}21$
McLane. " $129 = {\cdot}69$ " $4{\cdot}14^3 = 1{\cdot}00$ then $\frac{1{\cdot}00}{{\cdot}69} \times \frac{2{\cdot}21}{1{\cdot}00} = \frac{1{\cdot}52}{1{\cdot}00}$

Showing that, in this trial, the application in the Spencer was 1·52 to 1 more efficient than that in the McLane.

2.

Spencer. Power, $192 = 1{\cdot}00$ effect $6{\cdot}48^3 = 1{\cdot}5$
McLane. " $147 = {\cdot}76$ " $5{\cdot}67^3 = 1{\cdot}0$ then $\frac{1{\cdot}00}{{\cdot}76} \times \frac{1{\cdot}5}{1{\cdot}0} = \frac{1{\cdot}14}{1{\cdot}00}$

Showing that, in this trial, the application in the Spencer was 1·14 to 1 more efficient than that in the McLane.

3.

Spencer. Power, $1{\cdot}50 = {\cdot}96$ effect $6{\cdot}36^3 = 1{\cdot}00$
McLane. " $1{\cdot}55 = 1{\cdot}00$ " $6{\cdot}78^3 = 1{\cdot}21$ then $\frac{{\cdot}96}{1{\cdot}00} \times \frac{1{\cdot}00}{1{\cdot}21} = \frac{1{\cdot}00}{1{\cdot}16}$

Showing that, in this trial, the application in the McLane was 1·16 to 1 more efficient than that in the Spencer.

4.

Spencer. Power, $76 = 1.00$ effect $4{\cdot}62^3 = 1{\cdot}2$
McLane. " $52 = {\cdot}68$ " $4{\cdot}34^3 = 1{\cdot}0$ then $\frac{1{\cdot}00}{{\cdot}68} \times \frac{1{\cdot}2}{1{\cdot}0} = \frac{{\cdot}82}{1{\cdot}00}$

Showing that in this trial, the application in the McLane was 1 to ·82 more efficient than that in the Spencer.

5.

Spencer. Distance run, 23·0 miles, effect $23^3 = 1{\cdot}04$ then $\frac{1{\cdot}04}{1{\cdot}00}$
McLane. " " 22·7 " " $22{\cdot}7^3 = 1{\cdot}00$

Showing that, in this trial, the application in the Spencer was 1·04 to 1 more efficient than that in the McLane.

6.

Spencer. Power, 220 = 1·00 effect $7{\cdot}2^3 = 1{\cdot}05$ then $\frac{1{\cdot}00}{{\cdot}98} \times \frac{1{\cdot}05}{1{\cdot}00} = \frac{1{\cdot}03}{1{\cdot}00}$
McLane. " 216 = ·98 " $7{\cdot}07^3 = 1{\cdot}00$

Showing that in this trial the application in the Spencer was 1·03 to 1 more efficient than that in the McLane.

[D.]

Having stated, in the foregoing papers all the particulars connected with the experimental trials of the steamers McLane and Spencer, I find, in passing them in review, a difficulty in forming any definite conclusions upon the subjects under inquiry.

Notwithstanding the care with which the trials were made under the skilful management of Captains Fraser and Howard, very little of a satisfactory character was elicited. On the contrary, the results tended rather to confuse than to elucidate: certainly they furnished no criterion by which to determine the relative properties of the propeller and the side wheels, and the causes may, in my judgment, be justly ascribed to the defective form of the bottoms of the vessels.

It may be assumed by some, that as the models and dimensions of the two vessels were precisely alike, and the steam force exerted upon their respective propelling power was the same, the results *ought* to be conclusive of the superiority of the propeller—but such is not my opinion.

Captains Fraser and Howard both affirmed, and I give much weight to their professional opinions, that neither vessel would stand up under canvas, that they would not stay under ordinary circumstances, and it was difficult to wear them within any reasonable space, or to keep them to the wind in heavy weather—that in fresh breezes, on the wind, the lee wheel of the McLane would be immersed almost to its axis: in a word, that they were unmanageable at sea, and in their belief would be unsafe if thrown upon a lee shore in a heavy gale, even if assisted by steam power.

It is plain, therefore, that no application, whether of steam power or sails, or both combined, to vessels of such unusual model, could by possibility produce any satisfactory results, illustrative of the question of relative merits of the two modes of propulsion: and this opinion is strengthened by the fact, that on the occasion of their first day of trial in the Sound, when there was a strong double-reef topsail breeze from the northward and westward, they were so slow in their movements, that all agreed that any fair *sailing* vessel would have worked from New London to Falkner's Island, and made the run

back, in a less space of time than was occupied by the fastest of the two steamers in accomplishing it.

Respectfully submitted,

M. C. Perry.

Explanation of Plates.

Plate 2.—Plan of gearing on board the Revenue Steamer "Spencer," with two of Loper's Propellers.

Diameter of Propeller, 8 feet.

Width of blades at hub, 2 feet 3 inches.

" " outside, 4 feet 4 inches.

Angle of " at hub, 30°

" " outside, 54.°

Vertical wheel—75 cogs, (wood.)

Horizontal wheel—60 cogs, (iron.)

Relative revolution of engine and propeller, 1 to 1·25.

Plate 3.—Plan of gearing (side wheels) on board the U. S. Revenue Steamer "McLane."

Fig. 1.—Wheel, with wooden teeth, on upper shaft 7 feet diameter, 16 inches face—72 teeth.

Pinion on engine shaft, 4 feet 6 inches diameter, 16 inches face, 47 teeth.

The wheels are formed of two wheels, each 8 inches wide, placed together with the teeth off-set, to prevent any back-lash or jar. *a*, deck; *b*, water line; *c*, keel; *d*, engine frame.

Fig. 2.—Length between perpendiculars, 143 feet. *e*, water line McLane. *f*, water line Spencer.

Area of Cross Section.—Spencer—166 square feet, load line.
McLane—167 " "

On the Crystaline Fracture of Wrought-Iron, and the Causes of the same. By M. Aug. Malberg.

Continued from page 124.

In order to form a correct idea of the action of the rollers compared with that of the hammer, relatively to the grain of iron, I made the following experiment:—After having worked the iron in a puddling furnace, blooms about a foot square were placed one upon the other, and introduced in that position into the welding furnace, and after being sufficiently heated they were forged with a hammer of 1000 lbs. weight into a square bar, of between 5 and 6 inches in breadth. This bar was afterwards replaced in the furnace, and well rolled.

On afterwards examining iron manufactured in this manner, it was found, on comparison with that produced by the preceding process, that it was not drawn so well, that its fracture was more granular, and that this texture extended sometimes over the whole sectional surface. This grain, however, was not coarse, but was fine and of good quality, and of a nature to disappear on being again worked, as I was convinced when forging the iron again. In some places in the bar, the different textures of the two blooms forming the bar could be distinctly seen, the one being of a long fibrous texture, and the other granular. It would seem from this, that the first method was more advantageous than the second, without reckoning another advantage, which consists in this, that, immediately after the first rolling, the bars

may be examined, and those of inferior quality placed on one side together; whilst, by the latter method, it is only after all the manufacture is completed, and when nothing else remains to be done, that any notion can be formed of the results. It would, therefore, be necessary, that all the pieces which are required to be of a very fibrous or firm texture should be wrought by the rollers rather than the hammer; as, by the former, on the one hand, a more powerful pressure can be exerted than by the latter, and, on the other hand, the drawing out of the grain being effected principally in a longitudinal direction, a more fibrous texture can be obtained.

With regard to the relative resistance which iron of a fibrous nature possesses, as compared with that of a granular character (the two methods of manufacture above mentioned only being considered), I have found that the tenacity, absolute as well as relative, and also the limit of elasticity, were less in the granular than the fibrous texture.

The absolute resistance offered by the granular iron was from 68 to 70 lbs., and the fibrous iron from 72 to 74 lbs., for every 25th of an inch square, the thickness of the bars being 6¼ inches by 7¼ inches.

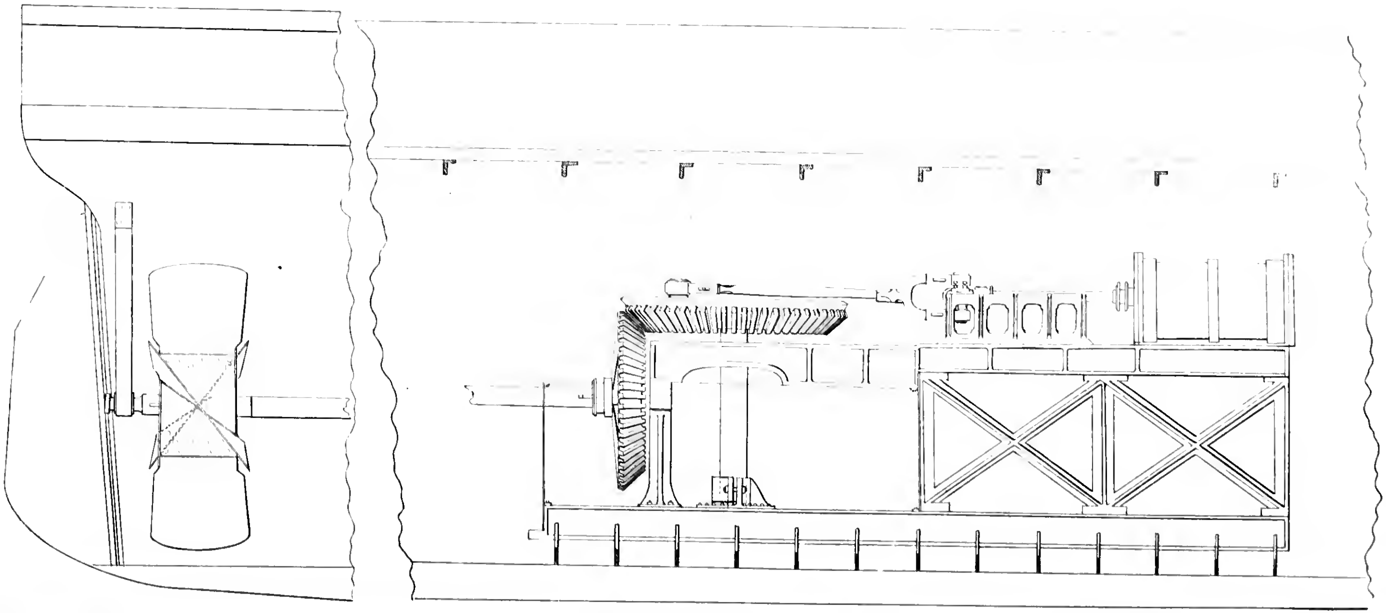
As regards relative resistance, the granular is much inferior to the fibrous iron. Thus, in order to break it upon the anvil, fibrous iron required 18 or 20 blows of the hammer, whilst the granular iron only required 10 or 12, or at the utmost 15 blows.

The limit of elasticity was generally for the fibrous iron from 32 to 34 lbs. for every 25th of an inch square, and even extended to 38 lbs., whilst for the granular iron it stopped at 30 lbs. The progression of permanent extension, after the limit of elasticity has been exceeded, is not only less in the fibrous iron, but is also less regular in relation to the weight or force employed. I would also remark that the temperature at which the iron is rolled, and, above all, the degree of heat at which it is passed through the two or three last grooves of the rollers, has great influence upon the limit of elasticity. At a red heat, this limit may, for fibrous iron, be made to amount to 40 or 41 lbs. for every 25th of an inch square.

The following data of the difference between rolled and hammered iron were taken from experiments made upon the axles when the Rhine Railway was established.

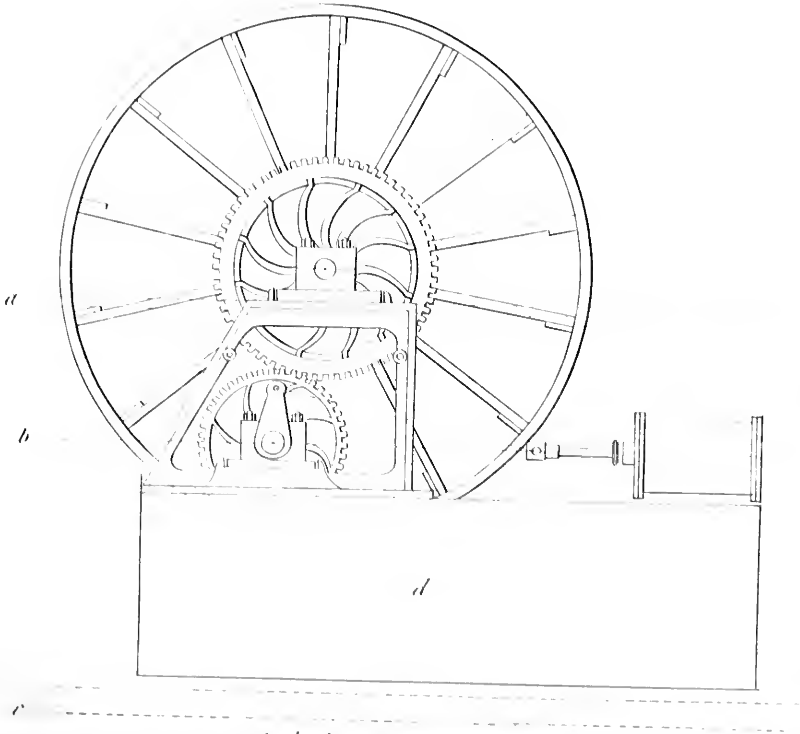
1st. Nine axles, which had been in use (six being made of hammered and three of rolled iron), were placed upon supports, and a monkey weighing 1112 lbs. was allowed to fall upon them from a height of 16 feet. Of the six made of hammered iron four were broken and two bent, whilst those made of rolled iron were not injured in the least.

2nd. Six new axles, five hammered and one rolled, were submitted to the same test. Three of the five hammered axles were broken, and two bent, while the rolled axle was submitted to three blows of the monkey without being at all affected. From these facts the conclusion may be arrived at, that there exists a more intimate combination of the molecular particles in axles of rolled iron than in hammered iron, and also that they possess greater tenacity, while these latter, on the other hand, possess greater rigidity.



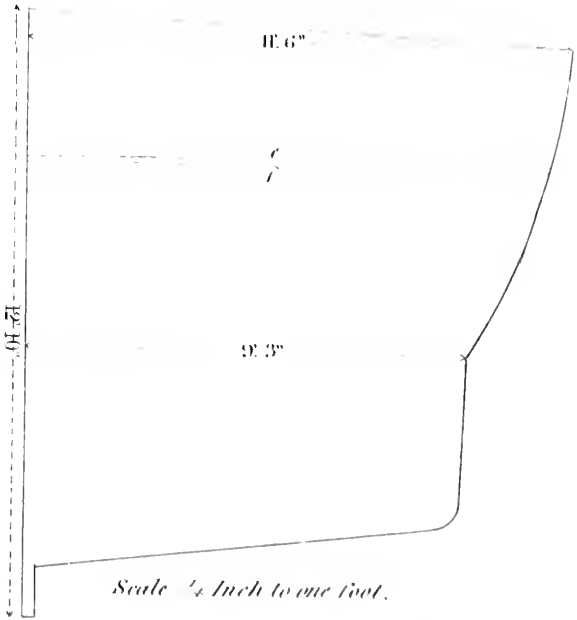
Scale 3/16 Inch to one foot.

Fig. 1.



Scale 1/3 Inch to one foot.

Fig. 2.



Scale 1/4 Inch to one foot.

3rd. With regard to the hammered axles broken under the monkey, whether new or old, they in general presented a more crystaline fracture than the rolled axles, and very frequently flaws and cracks were detected.

4th. The observation has been already made that iron broken with a great weight presents a very different aspect to that broken by a small hammer; but we may add to this, that rolled iron will resist the blows for a length of time, and present a fibrous fracture, whilst the hammered iron presents a fine and somewhat steel-like grain, and breaks a long time before the rolled iron.

I will now proceed to the question as to the manner in which iron that has acquired a fibrous texture by the first manufacture may be deteriorated by subsequent operations.

It has been previously stated, that, when the welding heat is too great, the fibrous texture of the iron will be changed into a granular crystaline texture. This transformation may be easily studied by welding two pieces together. I have frequently repeated the experiments which I will now describe, and have invariably observed the following results:—

The fractures of two bars of iron, 2 feet in width, and $1\frac{3}{8}$ inch in thickness, on being examined, presented an equally fibrous texture. Their extremities were then hammered at a high temperature, until the thickness was reduced to $\frac{3}{4}$ inch, and afterwards brought to a very high welding heat, and welded together by hand. After being left until quite cool, they were struck upon the edge of an anvil, at the welding point. This welding had been completely successful, and even at those points the iron was of a fibrous texture. On cutting through the bar, at a distance of 2 inches from the welding, the texture was still crystaline, but more especially at the edges. At a distance of about 3 inches the iron was still less crystaline, and at $6\frac{1}{2}$ inches the fibre of the iron was found not to have undergone any change.

In other bars which were cut, the fibre of the iron was found perfect nearer the welding point, and at not more than 4 or 5 inches therefrom; this arose probably from a less length of bar having been heated.

The conclusion may therefore be drawn, that too high a welding heat will invariably render the iron crystaline; but that, if two bars are welded together, the welded parts will not retain the crystaline form, which arises from the crystaline particles being flattened by the blow of the hammer, and rendered fibrous. I will not be certain, however, whether the blows of the hammer, which ought only to act upon the welded parts, do not assist in the crystalization of the adjacent parts; but this is certain, that if the phenomena which present themselves on the crystalization of liquid bodies be taken into consideration, for instance, the fact that ice, even in still water, is not formed at 5° or 8° below zero, but is formed on the slightest disturbance of the water, it is to be presumed that the shocks produced by the blows of the hammer upon iron heated to a high temperature, and which, in that state, approaches the point of fusion, may not be with-

out influence. At any rate a categorical answer to this question is not absolutely necessary for the case in point, and the fact may be considered to be clearly demonstrated, that a strong white welding heat renders fibrous iron crystaline. I have convinced myself of this fact by a great number of experiments, even without having recourse to simultaneous welding.

In these experiments it might be objected that the working of the iron produced the crystaline texture; but I caused bars to be cut which had been worked from a red to a deep orange red, and I found that, in the parts worked, the iron fibre, although somewhat shortened, and therefore scarcely perceptible, did not present any absolute alteration in the adjacent parts. It is, however, different with regard to iron worked at a high temperature; the crystaline structure is perceptible in this case, and in a greater degree than in a bar which was simply heated.

With regard to the resistance of that portion which became granular by the application of a white heat, it appears, from my experiments, to present some analogy with that of the kinds of iron which have remained granular from a previous treatment. It may be, however, that a greater or less degree of white heat has some effect on the quality of the iron. Besides, the temperature at which one sort of iron may be welded is not the same for other sorts. With several kinds, this temperature was so high that the point of fusion was very near the welding point; but, in general, iron of this kind is not fit for welding.

After having thus convinced myself by experience that iron acquired a granular texture when heated to a very high temperature, I made experiments with regard to the manner in which it was effected, as to whether certain results could not be obtained in working.

In order to assure myself whether simple heating without hammering would produce a change, I caused the bar No. 3, above mentioned, which had been heated to a very high temperature in the welding furnace, to be cut into two portions; one of these portions was brought to a red and the other to a white heat, but not to a welding heat: I had previously hammered portions of these two bars, and I repeated this operation upon the bars after being heated. In one of these portions (that which had been brought to a red heat) the fractures of the parts hammered in a cold and a hot state, were identical,—both were granular and crystaline; the resistance offered when struck upon the edge of the anvil was also very considerable, both before and after heating, which had not been supposed from inspection of the fracture. The color was the same in the other portion carried to a white heat, and it was not different from the former either in the fracture or resistance. I also caused the bar No. 4, which had been first heated in the welding furnace, and then carried in the same furnace to a moderate welding heat, to be cut into two pieces, one of which was heated to a red and the other to a white heat. The results with both these portions were identical. after heating and under the hammer, as respects the fracture, the color, and the resistance. The conclusion from

this would seem to be, that re-heating iron to a heat less than full white heat has not any injurious influence upon the metal.

In order to get a correct idea of the changes which the iron undergoes when worked at a heat less than the welding heat, I took a certain number of bars, which I rolled out at a good red heat, and I remarked that the ductility, and also the absolute resistance and limit of elasticity were thus augmented in the iron, which is in accordance with a well-known fact, viz :—that iron thus treated, when broken upon the edge of the anvil, presents less resistance, which is owing to an increase in density, and also to the fact that the iron, having thus lost part of its elasticity and tenacity, becomes of a more brittle and rigid nature. My experiments on this head were made upon bars from an inch to an inch and a half in thickness, and consequently the results were not, perhaps, very conclusive, for which reason I will not enter into the details; but, as some experiments have been made upon pieces of large dimensions on the Rhine railway, I will mention some few which appear worthy of notice.

A rolled axle, with forged pins and welded shoulder, was submitted to the action of the monkey, in such a manner that one of its spindles received the blow, the monkey falling from a height of 36 feet. The spindle was broken, and the axle bent and crushed, and the shock was such that the other spindle was broken and thrown up a height of more than 12 yards. The fracture in the spindles was grey, of a rather fine granular texture ; one of them, however, contained a layer of crystaline iron.

An axle, consisting entirely of rolled iron, was hammered at one end, while in a hot state, but so as to lose none of its strength. The monkey was allowed to fall upon it from a height of 16 feet, at a distance of an inch and a half from the forged end. The rolled part of the axle was somewhat curved, but the wrought portion was scarcely affected. The axle was then hammered all over, and left in the open air all night. The next day, on being again submitted to the monkey, from a height of 16 feet, it broke in the middle, and bent very little. The fracture was found to consist of a crystaline granular texture, of middling size and light color.

In these experiments it will be observed, that the axles were broken by the fall of a heavy weight, which is the reason that the faces of the fracture appeared more crystaline. If they had been broken by blows with a small hammer, this would not have been the case ; at least I have never found, although I have made a great number of experiments on this head, that by hammering at a red heat (when the iron had not been submitted to any operation of a nature to deteriorate it) the fibrous texture has disappeared. When, however, the rupture is effected by the monkey, the fibres of the iron, rendered dense and brittle, separate violently and instantaneously, and the fracture acquires a granular aspect, but the fibre is nevertheless not destroyed. The drawing out of the iron into rods is a conclusive proof of this, and another experiment made on the Rhine railway furnishes further evidence of the fibre not being injured.

In order to ascertain whether rolled axles which are submitted to a

second welding heat and hammered by hand would thereby lose their tenacity, an axle was broken with small hammers in the part wrought. The fracture presented no alteration, but was, on the contrary, remarkably fibrous and tenacious. It is, therefore, evident that this case is not precisely similar to the preceding ones, and yet the iron had been hammered at a welding heat. It may, therefore, be concluded from this experiment, that when the hammering is not very violent, and the iron is not worked at a greater heat than red heat, it will not be rendered brittle, and this result I have always seen confirmed in working large pieces.

It now only remains to inquire how to avoid rendering iron brittle by hammering, and if that be not possible, how that defect may be made to disappear. Iron is always brittle in some degree, but hammer-forged iron is always denser and harder. When, however, the hammering is performed at a low welding heat, and when, on being re-heated, it is not raised above that temperature, the hammering will have but little influence in augmenting its brittleness. If, through necessity or negligence, iron has been worked at a low heat, the brittleness may be diminished by heating the iron to a dull red, and letting it cool slowly, as has been proved by Mr. Nasmyth's experiments. It is not easy to determine whether by re-heating, the cohesion or tenacity of hammered iron is diminished in the same degree as rolled iron, for in neither can the action of the various influences be distinguished, and a comparison is, consequently, impossible. According to the experiments of M. Brix upon the resistance of rod-iron, the absolute resistance of the rods which had been reheated was never less than the resistance of the bar-iron from which they were drawn. My observations upon the re-heating of iron render it probable that drawn iron is, in a slight degree, softer than before that operation. But, as in the latter case, the absolute resistance had somewhat diminished, I have not yet had time to assure myself by direct proof, although the density had evidently augmented.

It is very seldom necessary to submit bar-iron which is to be exposed to various causes of rupture to cold hammering, and it is never indispensable:. Lond. Jour. of Arts. & Sci.

Observations on the effect of using Steam expansively under different pressures, and when cut off at different points.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Gentlemen:—I was led to the following calculations respecting steam. by a notice published some time since in your work, of the operation of the Cornish engines. The writer of that notice intimates, that the "duty," said to be performed by the engines, is greater than the calculated power, to be derived from the fuel, and that a new theory has been proposed to account for it, by the "momentum" of the percussion of the steam upon the piston. He states that in some of the engines the steam is let into the cylinder at a pressure of 45 lbs. to the inch, and "cut off" at one fourteenth of the stroke. As I could

find no table showing the effect of the expansion of steam when carried so far, I prepared the following.

Steam let on during the	Effect produced by expansion.	Total effect of the steam used.	Average effect throughout the cylinder.
Full Stroke.	0·000000	1·000000	1·000000
$\frac{1}{2}$ do.	0·693151	1·693151	·846575
$\frac{1}{3}$ do.	1·098616	2·098616	·699538
$\frac{1}{4}$ do.	1·386303	2·386303	·596575
$\frac{1}{5}$ do.	1·609448	2·609448	·521889
$\frac{1}{6}$ do.	1·791768	2·791768	·465294
$\frac{1}{7}$ do.	1·945927	2·945927	·420846
$\frac{1}{8}$ do.	2·079455	3·079455	·384932
$\frac{1}{9}$ do.	2·197233	3·197233	·355248
$\frac{1}{10}$ do.	2·302600	3·302600	·330260
$\frac{1}{11}$ do.	2·397904	3·397904	·308900
$\frac{1}{12}$ do.	2·484919	3·484919	·290401
$\frac{1}{13}$ do.	2·564958	3·564958	·274227
$\frac{1}{14}$ do.	2·639078	3·639078	·259219
$\frac{1}{15}$ do.	2·708064	3·708064	·247204
$\frac{1}{20}$ do.	2·995751	3·995751	·199787
$\frac{1}{25}$ do.	3·218896	4·218896	·168755
$\frac{1}{50}$ do.	3·912048	4·912048	·098240
$\frac{1}{100}$ do.	4·605200	5·605200	·056052

From the above table it appears that one per cent of a cylinder full of steam, if suffered to expand, will give an average pressure throughout the cylinder equal to 5·6 per cent of the pressure it exerted when entering the cylinder; or that the same quantity of steam, if suffered to expand to 100 times its volume, will do 5·6 times as much work as if used, without expansion, through the whole stroke of the cylinder. And when cut off at $\frac{1}{14}$ of the stroke, as in the Cornish engines, the average pressure will be more than one fourth of what it would have been, if fourteen times as much steam of the same pressure had been used. This sufficiently explains the cause of the superiority of the "duty" performed by the Cornish engines over those in which expansion is not carried to so great an extent; for it requires less water to be raised into steam to work expansively than would be required to work with steam of the same average pressure, and full cylinders. In the case of the Cornish engine the steam was used at 45 lbs. pressure for $\frac{1}{14}$ of the stroke, giving an average pressure, agreeably to the table, of ·259219 × 45 lbs. = 11.665 lbs., and to perform the same work, with the full stroke, would have required steam of at least this average pressure. Now to determine the quantity of water required. Dalton says that steam obeys the same law as the gases with respect to pressure, and *they* have expansive force in the ratio in which they are compressed. Then steam of double pressure should contain a double quantity of water. The published tables of the specific gravi-

ties of steam give an addition of weight of only about 87 per cent. to steam of double pressure, which would contradict Dalton's position. Supposing, however, that Dalton's law is correct, and that atmospheric steam contains 253 grains of water to the cubic foot, then steam having the above pressure of 11·665 lbs. would contain 435 grains; and steam of 45 lbs. pressure would contain 1012 grains of water per cubic foot. But, with this last, it requires but $\frac{1}{14}$ of the quantity, or ($\frac{1012}{14}=$)72 grains to give the same average power, when used expansively, as the 435 grains on the full cylinder plan. The fuel required should be in proportion to the water to be evaporated. Watt's experiment with the open and closed boiler, each subjected for an equal time to an equal heat, showed that the same quantity of water had escaped, in steam, from the open boiler, as flew off from the close one, upon opening the valve, at the end of the operation; thus proving that equal weights of water require equal quantities of heat to raise them into steam, irrespective of pressure. On this principle, then, the Cornish engine should require but $\frac{72}{435}$ or about $\frac{1}{6}$ of the fuel that would have been required to work them on full steam, which very nearly corresponds with the "duty" performed by the present Cornish engines compared with that done by the engines formerly constructed by Bolton & Watt in the same locality.

Another principle comes in play, in working expansively, which is lost sight of when working with equal steam throughout the stroke—viz: that matter in motion would never cease to move unless retarded by external causes, and would require, to stop it, a power equal to its weight multiplied by its velocity. Now, in working expansively, the steam is applied at a pressure sufficient to start the load at a certain velocity, to continue which, it is only necessary that the additional quantities of power should equal the retarding forces of gravity, friction, and resistance of air, until the commencement of the next stroke. Now in the Cornish engine, where the steam is cut off at $\frac{1}{14}$ of the stroke, the increments of power beyond that point, or that portion of the power gained by expansion, amount to nearly 2·64 times the direct power of the steam applied, and which gave the original velocity. This velocity must therefore be continued until the gravity, friction, and resistance of air, amount to 2·64 times the original power, applied before cutting off the steam. The whole weight of the machinery and load thus operates, on the flywheel-principle, to continue the motion, as the velocity given to them forms one of the factors of their momentum, which is counteracted only by the other factor, the gravity.

It is thus readily seen that the weight of the load raised by an engine working expansively, may exceed the average pressure of the steam on the piston, for it only requires the steam to be at a high initial pressure, so as to give the necessary velocity, and of course momentum, to the load at the commencement of the stroke; it may then expand so as to bring down the average pressure and leave sufficient power, to be derived from the momentum and the expansion, to carry forward the work. This reserved power will of course be applied in a decreasing progression, while the retarding powers would be constant. It will be a useful exercise of the skill of some of your mathe-

matical friends to calculate how far the load may exceed the average pressure upon the piston.

It appears from the table that the advantage to be derived from expansion, increases with the expansion. It becomes therefore important to ascertain the extent to which it may be carried. I noticed that in the Cornish engine they use a "steam jacket" to their cylinder to prevent condensation. This led me to inquire into the heat of the steam, and how it would be affected by its expansion. Will steam expand in a cylinder from any given pressure down to that of the atmosphere? Pressure or condensation of air produces heat, and the release of it from pressure, cold. If steam be affected in the same way, and you suffer it to expand to 100 times its bulk, will not its heat be divided by 100, and be reduced below the freezing point? The cut-off steam can take up no heat from the boiler, and its inherent heat is stated to be about 1212° divided into portions, sensible and latent, according to its pressure. As each particle of steam must be supposed to contain an equal portion of heat, the heat must necessarily be divided with the expansion of the steam. Then if it contain but 1212° and this be divided by the expansion, it is evident that before the steam can have expanded 40 times, its heat would be reduced below the freezing point, even if the latent heat all became sensible, unless it could take up heat from the cylinder, which is not of a nature to conduct it with sufficient rapidity. That the heat is divided by the expansion, any one may satisfy himself by placing his hand in the steam issuing from a high pressure boiler. He will in the same way be convinced that steam is not frozen by expanding from 150 lbs. to the pressure of the atmosphere. Now it is impossible that in this case it should take up from the atmosphere sufficient heat to prevent freezing, if the heat, originally in it, did not exceed 1212° as indicated by our books. To account for the phenomenon, I suppose we may assume that the heat in atmospheric steam is correctly stated at 1212°, of which 212° are sensible, and 1000° latent—a second volume of water, rising in the form of steam in the boiler, takes up an additional 1212° of heat, and now, the steam contains twice as much water, and twice as much heat, as atmospheric steam, shows 15 lbs. pressure by the mercurial gauge, and about 242° of heat by thermometer, the remaining 2182° being latent: and so, for each additional 15 lbs. of pressure, another volume of atmospheric steam would be compressed into the original space, a less portion of its heat, each time, becoming latent. On this theory, steam of 150 lbs. pressure will contain 11 times as much water as atmospheric steam, and 13332° of heat, while the thermometer would show but about 360°. And the temperature of such steam, when expanded to the atmosphere should be 88°. It would therefore rush into the air and immediately assume the form of water, which judging merely from the sensation is near the fact. The advantage of the "steam jacket" therefore is obvious. It is also obvious, that steam of any pressure may be used, on the plan of expansion, in a condensing engine, as the heat may always be reduced, by expansion, to the point at which it may be condensed. The follow-

ing calculations seem to show, that the most economical engine would be built upon this plan.

Steam at 180 lbs. pressure, cut off at $\frac{1}{100}$ of the stroke, by the table, will give an average pressure of 10 lbs. to the whole cylinder, and, by adding the vacuum and air pump, 10 lbs. more may readily be obtained. Such an engine would therefore give a power equal to two of Bolton & Watt's, of the same size, worked with atmospheric steam. Proceeding on the data, that equal quantities of water are to be evaporated for each lb. pressure of steam, at the same expense of fuel, on both plans, we have two cylinders-full of atmospheric steam weighing 253 grains per cubic foot on the Bolton & Watt plan, and only $\frac{1}{100}$ of one cylinder-full of steam at 180 lbs., weighing 3289 grains per cubic foot, in the other. The water to be evaporated to produce the same power in both will then compare as 253 to $\frac{3289}{200}$, or, the Bolton & Watt engine will require $15\frac{1}{3}$ times as much water to be evaporated as the other, and fuel and boiler in the same proportion. The 180 lbs. steam, by the theory, would contain 15626° of heat, which divided by the expansion, 100, would be reduced to 156°, while in the atmospheric steam there would be 1212°, or nearly 8 times as much. Of course the condenser, airpump, and condensing water, need only be $\frac{1}{16}$ of what the two Bolton & Watt cylinders would require for the condensing process.

If Dalton be correct in the opinion that steam, like gas, has expansive power in proportion to its compression or density, we have data to calculate the maximum power of steam. Water is found to expand nearly 1800 times into steam of atmospheric pressure, or 15 lbs. to the inch. Then, by compressing such steam to $\frac{1}{1800}$ of its bulk, we should get it back into water, and multiply its elastic force in the same degree, $1800 \times 15 = 27000$ lbs. per square inch, the maximum.* In following the same law of elastic power in proportion to density, we find, that each expansion of steam to twice its volume, in a steam cylinder, gives precisely the same increment of power to the piston, which must move each time double the distance. Thus the distances moved by the piston for each expansion, form the series 1, 2, 4, 8, &c., and the increment of power for each distance is ·693151 of the power applied before the steam is cut off.

Yours, Erskine Hazard.

Philadelphia, July 20th, 1846.

An Address on Ventilation; delivered by J. Toynbee, Esq., F. R. S., *Surgeon to the St. George's and St. James's General Dispensary, before the Institution of British Architects, June* 8, 1846.

Mr. Toynbee introduced the subject by stating that during the whole of his professional career he had almost constantly been attached to public medical institutions; and that he had slowly become aware of

* Steam thus compressed into water, would instantly give out all its heat, and prodcue a temperature, according to the theory, of $212° \times 1800 + 1000° = 382600°$.

the existence of an enormous amount of disease in the human race. A large share of this disease was incurable when once produced; but he was in a position to prove that much of it could be wholly prevented. He, therefore, felt that it was the duty of medical men, while they devoted themselves to the cure and palliation of disease, also to exert themselves in behalf of preventive measures. In the performance of this duty, he had investigated the sources of disease; and he found that one of the most fertile was the want of a due supply of air in dwellings and public buildings. In speaking on the *Necessity for Ventilation*, it was shown that 10 cubic feet of air, or a volume double the size of the person, is required for the purposes of respiration and transpiration each minute. The circulation of the blood was described as the process of carbonization—respiration as the process of decarbonization, in the 170,000,000 air cells, forming a surface 30 times as large as that of the skin. In the process of transpiration, the so-called insensible perspiration was continually given off; which, together with the vapor expelled from the lungs, amounted to two fluid ounces every hour. Thus, 500 people in a church during two hours give off fifteen gallons of water into the air; which, if not carried away, saturates every thing in the building, after it has been breathed over and over again, in conjunction with the impurities it contains collected from each individual. The use of lamps, gas, and oil, was shown to deteriorate the air, and to add much moisture to it. The effects of neglect for carrying out plans for ventilation are shown in the production of three of the most formidable and frequent diseases which affect the human race—fever, scrofula, and consumption. Numerous facts were adduced in proof of this view; and the way in which these diseases were produced was pointed out. Thus, it was shown that all those who were among the victims in the Black Hole of Calcutta, and did not perish from immediate suffocation, died, in a short time afterwards, of putrid fever. The proportion of people dying of consumption who follow in-door occupations is double that of those who work out of doors; and it increases as the space for labor is more contracted. Dr. Guy has shown that it is more common in the upper parts of large establishments, as printing-houses, &c., where the air is most vitiated. The inhabitants of towns exposed to the wind are much less liable to consumption than those which are well protected and sheltered; and the goître afflicting the inhabitants of the valleys of the Rhone is produced by a stagnation of air. Instances were cited of schools in which the mass of the children were scrofulous, and to whom an increased diet, warmer clothing, &c., was not productive of any benefit—and by the aid of proper plans of ventilation the disease disappeared entirely. The same result has taken place in the Zoological Gardens, Regent's Park, since the new dens opened to the air have been in use. It was then shown that hitherto there had been a total absence of plans for the supply of pure air, in a sufficient quantity, to the abodes of human beings. Towns are erected in localities wholly unadapted for residences. They are constructed so as effectually to exclude the air, and often increase to so large a size as to be rendered, from that cause alone, most unhealthy.—The

last portion of the address was devoted to the consideration of the means to be adopted for securing an efficient ventilation. The example set by nature ought to be followed; and the gentle changes produced by the wind should be as much as possible imitated. The great principle is to admit into rooms and houses a *large quantity of air at* a moderate temperature (60° to 65°:) and that there should be an outlet for the vitiated air: the pure air to be admitted within 3 or 4 feet of the floor, and to be warmed by aid of the fire-place. The various plans for warming the fresh air were examined; and their errors were found to have been, that a small quantity was admitted through a narrow channel, and at a temperature much too high, so that its nature was deteriorated. The subject of warming abodes was also alluded to; and it was shown that, from the bad mode of construction of stoves and fire-places, and from improper materials being used, the smoke was not consumed, ventilation was rendered impossible, and the greater part of the heat was dispersed up the chimney. Mr. Toynbee was happy to say that he had recently examined some plans about to be patented by a gentleman who had devoted a long life to the subject, and brought to it great chemical and practical knowledge—in which these evils would be remedied, and important advantages gained. In speaking of the means for insuring the egress of vitiated air, it was stated that, as its temperature, on escaping from the mouth, is between 80° and 90°, it rises to the upper part of the room—from which there should always be a means of escape. Dr. Arnott's valve had been generally used for this purpose; and thousands of people will be indebted to its use for their lives and health. If it were the custom of this country to erect statues in memory of those who, like Jenner, saved the lives of thousands of their fellow men, Dr. Arnott, in manifold ways, had earned for himself this distinction. A modification of Dr. Arnott's chimney-valve, by Daw, a working man, was alluded to, and displayed,—having the advantage of always remaining open, unless voluntarily closed. Various suggestions were made, showing how plans of ventilation may be carried out; and Mr. Toynbee concluded by appealing to the architects to adopt efficient plans in the construction of buildings—by doing which, they would confer unbounded good upon the public, by the improvement of the public health.

Dr. Buckland and R. A. Slaney, Esq., a member of the Health of Towns Commission, offered some remarks on the ill effects arising from badly ventilated apartments, and from the effluvia escaping out of the gratings in the streets, which are connected with the sewers. Suggestions were offered for ventilating the sewers by means of a gas light burning within lofty air shafts.

Models were exhibited by Mr. Stedall, of his patent Scolecothic ventilator; adapted for the cure of smoky chimneys, and for the admission of fresh air into the engine-rooms and other confined parts of vessels.

Athenæum.

Indian Paper Manufactory.

A paper, by Capt. Postans, 'on an Indian paper manufactory,' was read before the Asiatic Society, June 6. It was observed, that in most cases, the superior skill and science of English manufacturers had very injuriously operated upon the processes employed by the natives, most of which had been thus driven from the field of competition. But, in one instance, Captain Postans, in a journey through the Dekkan, found a village or small town wholly occupied in the manufacture of paper. This place is near Rozah, and is named Kharguzpore, or paper-town. It is of small extent—not exceeding fifty houses, all occupied by paper-makers. One of the head men of the place obligingly conducted Captain Postans through his establishment; and explained the whole process. The principle of the manufacture in nowise differs from the old European mode, with the modifications rendered expedient by the difference of climate and material. The latter is the ordinary coarse hempen bagging used by the *bringarries*, when torn to rags in their service. These rags are cut into small pieces, and well washed in the numerous tanks which surround the town,—the water of which is said to be peculiarly adapted for the purpose. The tanks are always quite surrounded by workmen, employed in washing, bleaching, and drying the rags; which, in about twelve days, are converted into a white pulp, and then made up into balls weighing about 4 lbs. each, and as big as a man's head. These balls are subsequently mixed with water in a small tank; and then made into paper upon a frame, precisely as in the old European mode, except that the frame is made of fine reeds instead of brass wire. A man and boy are employed in making the sheets; which are removed by a third workman, who first presses them under large stones to expel the moisture, and then plasters them against the walls of the manufactory to dry in the sun. The paper is afterwards covered with a gummy size, and polished by rubbing with smooth stones. Specimens of the paper produced both in the rough and polished states, were laid upon the table; and a sketch showing the process of manufacture exhibited. Ibid.

Observations on the more recent researches concerning the operations of the Blast Furnace in the manufacture of Iron. By Dr. J. L. Smith.

The great difference existing between metallurgic operations of the present day, and those of a former period, is owing chiefly to the ameliorations produced by the application of the science of chemistry to the *modus operandi* of the various changes taking place during the operations, from their commencement to their termination.

Copper and some other metals are now made to assume forms in the chemist's laboratory, that formerly required great artistical skill for their production—the chemist simply making use of such agents and forces as are at his command, and over which he has, by close

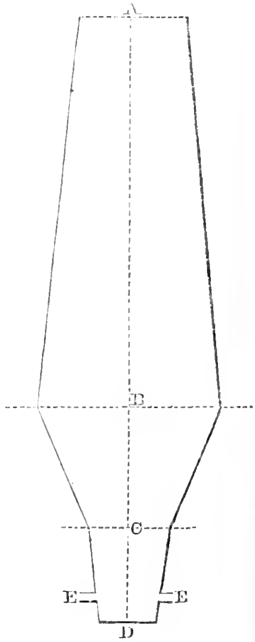
analytical study, acquired perfect control. Our object at present, is only to advert to the chemical investigations more recently made on the manufacture of iron, treating of those changes that occur in the ore, coal and flux that are thrown in at the mouth of the furnace, and in the air thrown in from below. For most that will be said on this subject, we are principally indebted to the recent interesting researches of M. Ebelman.

The importance of a knowledge of the facts to be brought forward in this article, will be apparent to every one in any way acquainted with the manufacture of iron. It will be seen that the time is not far distant, when the economy in the article of fuel, will amount in value to the present profit of many of the works. The consequence must be, that many of those works that are abandoned, will be resumed, and others erected in localities formerly thought unfit.

The daily increase of the demand for this article, in the construction of railroads and machinery, and the supply of this country falling short of its demands, are directing a large amount of capital towards the construction of furnaces, rolling-mills, and other iron works. The time is not far distant, when the silent influence of our extensive mineral resources will tend more to lay aside one of our great congressional bones of contention, than all the oratory of our statesmen.

It is well known, that the blast furnace is the first into which the ore is introduced for the purpose of converting it into malleable iron, and much therefore depends upon the state in which the pig metal passes from this furnace, whether subsequent operations will furnish an iron of the first quality or not. The interior of the blast furnace consists of three conical cavities, represented by the figure.

A, mouth of the furnace.
AB, fire-room "
BC, boshes "
CD, hearth "
EE, openings called tuyers.



The principal parts of the furnace are thus hastily alluded to, so that those not familiar with their names may readily understand what follows. In putting the blast furnace into operation, the first step is to heat it for some time with coal only. After the furnace has arrived at a proper temperature, ore, fuel, and flux are thrown in alternately, in small quantities, so as to have the three ingredients properly mixed in their descent. In from twenty-five to forty-eight hours from the time when the ore is first thrown in, the entire capacity of the furnace, from the tuyer to the mouth, is occupied with the ore, fuel, and flux, in their various stages of transformation.

In order to explain clearly, and in as short a space as possible, what these transformations are, and how they are brought about, we may consider—

1. The changes that take place in the descending mass, composed of ore, fuel, and flux.

2. The changes that take place in the ascending mass, composed of air and its hygrometric moisture, thrown in at the tuyer.

3. The chemical action going on between the ascending and descending masses.

4. The composition of the gases in various parts of the furnace during its operation.

5. The causes that render necessary the great heat of the blast furnace.

1. *Changes that take place in the descending mass, composed of ore, coal, and flux.*—By coal is here meant charcoal; when any other species of fuel is alluded to, it will be specified. In the upper half of the fire-room, the materials are subjected to a comparatively low temperature, and they lose only the moisture, volatile matter, hydrogen, and carbonic acid that they may contain: this change taking place principally in the lower part of the upper half of the fire-room.

In the lower half of the fire-room, the ore is the only material that undergoes a change, it being converted wholly or in part into iron or magnetic oxide of iron—the coal is not altered, no consumption of it taking place from the mouth down to the commencement of the boshes.

From the commencement of the boshes down to the tuyer, the reduction of the ore is completed. Very little of the coal is consumed between the boshes and in the upper part of the hearth; the principal consumption of it taking place in the immediate neighborhood of the tuyer.

The fusion of the iron and slag occurs at a short distance above the tuyer, and it is in the hearth of the furnace that the iron combines with a portion of the coal to form the fusible carburet or pig-iron. It is also on the hearth that the flux combines with the siliceous and other impurities of the ore. This concludes the changes which the ore, coal and flux undergo from the mouth of the furnace to the tuyer.

If the fuel used be wood, or partly wood, it is during its passage through the upper half of the fire-room that its volatile parts are lost, and it becomes converted into charcoal. M. Ebelman ascertained that wood at the depth of ten feet, in a fire-room twenty-six feet high, preserved its appearance after an exposure for 1¾ of an hour, and that the mineral mixed with it preserved its moisture at this depth; but three and a half feet lower, an exposure of 3¼ hours reduced the wood to perfect charcoal and the ore to magnetic oxide. The temperature of the upper half of the fire-room when wood is used, is lower than in the case of charcoal, from the great amount of heat made latent by the vapor arising from the wood. In the case of bituminous coal, Bunsen and Playfair find that it has to descend still lower before it is perfectly coked.

After the wood is completely charred, or the coal become coked, the subsequent changes are the same that happen in the charcoal furnaces.

2. *Changes that take place in the ascending mass, which is com-*

posed of air and hygrometric moisture.—The weight of the air thrown in at the tuyer in twenty-four hours, is twice that of the ore, coal, and flux, thrown in at the mouth during the same time.

The air, as soon as it enters the tuyer and reaches the first portion of coal, undergoes a change—its oxygen is converted into carbonic acid, and its moisture decomposed, furnishing hydrogen and carbonic oxide—after ascending a short distance, (12 or 18 inches,) the carbonic acid is converted into carbonic oxide—between this point and the upper part of the boshes it undergoes but very little change, having added to it a further small amount of carbonic oxide. So the ascending column at the top of the boshes is composed of nitrogen, carbonic oxide, and hydrogen—from this point it begins to undergo a change; the carbonic oxide diminishes, carbonic acid appears, and goes on increasing for about half the way up the fire-room; after which the carbonic acid, carbonic oxide, and nitrogen remain the same, when the hydrogen increases and moisture begins to appear and augment up to the mouth. The ascending mass, as it passes out of the mouth, contains the vapor of water, carbonic acid, carbonic oxide, hydrogen, and nitrogen. The nitrogen undergoes no alteration in its passage through the furnace, and the same is true of the hydrogen formed at the tuyer.

If wood be used, the gases passing out of the mouth are the same as those just mentioned, with an increased quantity of moisture, and the addition of those pyroligneous products arising from the dry distillation of wood.

In case of the use of bituminous coal, the gases alluded to have added to them ammonia, light carburetted hydrogen, olefiant gas, carburetted hydrogen of unknown composition, and sulphuretted hydrogen.

3. *The chemical reaction occurring between the ascending and descending masses.*—From the foregoing statements, we can, at a glance, see what are the materials to be met with in the different parts of the furnace, and can therefore readily study their reactions upon each other.

In the upper half of the fire-room, little or no chemical action is taking place, the ore, flux and coal, as already stated, simply losing their volatile parts. In the bottom of the upper half and the entire lower half of the fire-room, a reaction is taking place between the ore and the carbonic oxide of the ascending column, iron or magnetic oxide of iron and carbonic acid being the result. It must be borne in mind, that the coal has played no part in this reduction down to the commencement of the boshes Between the boshes, and in the hearth, no reaction appears to take place between the ascending and descending masses, but the reduction of the ore is completed by the direct action of the coal upon the remaining portion of the undecomposed ore, carbonic oxide being formed, and here is the first consumption of the coal in its passage downwards.

According to M. Ebelman the ore loses in the fire-room $\frac{28}{33}$ of its oxygen by the reaction of the oxide of carbon, and the remaining $\frac{5}{33}$ disappears in the boshes and hearth in the manner already stated, at the expense of from $\frac{6}{100}$ to $\frac{12}{100}$ of the entire amount of charcoal used.

The ore being now completely reduced, unites with a portion of carbon in the hearth, melts at about 13 inches from the tuyer, and descends into the crucible; and here also the flux combining with the impurities of the ore forms the slag which melts.

The coal and the air react upon each other most powerfully just in the neighborhood of the tuyer, where the most intense heat is produced; the oxygen becomes converted into carbonic acid, which, acting upon a portion of the ignited coal, is almost at the same moment reduced to carbonic oxide; the moisture of air acting on the ignited charcoal undergoes the decomposition already mentioned, hydrogen and carbonic oxide resulting therefrom.

When the ore is easy of reduction, the gas at the boshes is represented by 100 nitrogen and 52 5 carbonic oxide, *plus* the quantity of carbonic oxide and hydrogen afforded by the moisture.

It must be clearly understood that these rules do not apply to every variety of ore. They are especially applicable to the hematites and such ores as are either naturally porous, or become so in their passage through the fire-room of the furnace, thus increasing the surface of contact exposed to the action of the reducing agent, (carbonic oxide,) so that when it has reached the boshes the reduction is nearly complete.

The specular, magnetic, and siliceous ores are reduced with much more difficulty; most of the ore in these cases reaching the boshes but slightly altered, they being principally dependent upon the direct action of coal for their reduction; this circumstance largely increases the consumption of coal when any of these ores are employed; and the amount of caloric made latent, in consequence of the reduction requiring the direct action of the coal, is very great, whereas in the reduction of the ore by carbonic oxide no heat becomes latent: for the heat rendered latent by the oxygen of the ore becoming gaseous, is compensated by the sensible heat produced by the combination of the carbonic oxide with the oxygen. Where the reduction is produced by the carbon, with the formation of carbonic oxide, 1,598 units of heat are made sensible, while 6,216 are rendered latent, giving a difference of absolute loss of 4,618.

It should be the object of the metallurgist to reduce as much of the iron as possible by the oxide of carbon. Magnetic, siliceous and other hard ores should be reduced to smaller fragments than those softer and more easily managed. Were it possible to reduce them to powder without the danger of choking the furnace, it would be all the better, as the great object is to have a large extent of surface exposed to the carbonic oxide. The different capacity of different ores for reduction, shows the necessity of having furnaces of different dimensions for them respectively.

The matter which covers the melted metal in the crucible, and that which adheres to the interior of the hearth, contain silicate of iron and charcoal in a pasty state, and there is consequently a constant reduction of the oxide of iron, which gives rise to carbonic oxide; this gas bubbles through the slag, which if drawn off at this time, will, when cold, present a porous structure, a sure indication that the furnace is

not working well and that the slag itself contains much of the ore in the form of a silicate.

4. *Composition of the gas in various parts of the furnace during its operation.*—The analyses lately made by Ebelman are the most accurate and best detailed that we are in possession of. What follows has reference to a furnace worked with charcoal.

Gas taken from the mouth of the furnace and dried.

Carbonic acid,	12·88
Carbonic oxide,	23 51
Hydrogen,	5·82
Nitrogen,	57·79

The vapor of water in a hundred volumes of this gas, varies from nine to fourteen volumes. Examinations made at different times show the proportion of hydrogen and nitrogen to be nearly uniform, and that the sum of the volumes of carbonic acid and carbonic oxide is constant, but that there is a variation in their respective proportions.

Gas taken from the interior of the fire-room at 5 *to* 10, *and* 13 *to* 17 *feet from the mouth, (fire-room* 36 *feet.)* From five to 10 feet, the proportion of moisture diminishes, the other ingredients remaining about the same. From thirteen to seventeen feet, the proportion of carbonic oxide increases, while the carbonic acid and hydrogen diminish.

Gas from the bottom of the fire-room and top of the boshes. This is remarkable for the constancy of its composition, and for the absence of carbonic acid and watery vapor. Composition—

Carbonic oxide,	35·01
Hydrogen,	1·92
Nitrogen,	63·07

Gas from the bottom of the boshes and commencement of the hearth.

Carbonic acid,	0·31
Carbonic oxide,	41·59
Hydrogen,	1·42
Nitrogen,	56·68

Gas from the neighborhood of the tuyer.

Carbonic oxide,	51·35
Hydrogen,	1·25
Nitrogen,	47·40

The two last statements would appear to contradict the rules previously laid down, as regulating the operation of the blast furnace; for, according to them, the proportion of carbonic oxide at the top of the boshes should be a little greater than in the hearth, whereas the reverse would appear to be the case by the analyses here given. Besides, from a glance at the composition of the three last gases alluded to, it would appear that the gaseous products, as they ascended the furnace, lost completely a portion of the carbonic oxide, without a replacement by carbonic acid or other compound; in other words, a portion of it would apper to be completely annihilated, which of course is an impossibility. This apparent anomaly is easily accounted for, when it is stated how the gas was collected.

In order to obtain the gas from different portions of the furnace,

holes were bored into the side, and a tube inserted, by which it was drawn off. Allusion has already been made to the fact that a pasty mass adheres to the sides of the hearth, containing silicate of iron and charcoal, in which there is a constant reduction of the iron, with the formation of carbonic oxide. Now it is evident that the gas drawn off by a hole bored into the side of the hearth, will be largely mixed with this carbonic oxide forming in the immediate neighborhood of the opening, and that it cannot serve as an index to the character of gas passing through the centre of the hearth. M. Ebelman was aware of this fact, but he was not able to overcome the difficulties in the way of obtaining the gas under the proper circumstances.

Gas taken at the tuyer. Here it is little else than atmosphere mixed with a few per cent. of carbonic acid.

From these results it wlll not be difficult to admit that the oxygen of the air is converted immediately into carbonic acid, which is rapidly changed into carbonic oxide under the influence of an excess of carbon and the high temperature developed near the tuyer.

5. *The causes that render necessary the great heat of the blast furnace.*—The weight of the ore, flux, and combustible, which enter the furnace, being only one-half that of the ascending column, and as the specific heat of these three materials is very much below that of the gas of the ascending mass, it is not the heating of them that explains the necessity of the very great heat of the blast furnace. But the principal cooling causes are—

1. The drying of the ore, flux, and coal, and the expulsion of carbonic acid from the flux, &c., rendering much of the heat latent; for what was solid is now transformed to the gaseous state.

2. The reduction of the ore, or in other words, the transformation of the solid oxygen of the ore into gaseous oxygen. If the ore has been deprived of its oxygen by the action of carbonic oxide, with the formation of carbonic acid, the heat rendered latent by the oxygen, is compensated for by the heat developed by the reaction between the oxygen and carbonic oxide; which is the character of the operation that principally takes place in the lower part of the fire-room. If the ore has been deprived of its oxygen by the direct action of the coal, the amount of heat rendered latent is enormous, as already stated; for carbonic oxide is the result of this reaction, and the amount of heat developed by it falls far short of that rendered latent by the oxygen that has entered into its formation, assuming the gaseous condition—this is the character of the reduction taking place in the boshes and hearth.

3. The conversion of the carbonic acid near the tuyer into carbonic oxide has a powerful influence in cooling the upper part of the hearth; for of the 6,260 units of heat formed by the first action of the air upon the coal, 4,662 are rendered latent by the conversion of this carbonic acid into carbonic oxide.

This terminates what it was proposed to treat of; it is little else than a sketch of the chemistry of the blast furnace, sufficient to show its importance.

In a future article, some remarks will be made upon the amount of

combustible lost in the operation of this furnace, the recent methods employed to prevent this loss in the complete combustion of coal, the action of the hot blast, theory of the refining furnace, charring of wood, and other points of interest. Amer. Jour. of Sci. & Arts.

Suggestions for improving the manufacture of Optical Glass. By J. Nasmyth, Esq.

Mr. Nasmyth, after remarking that the problem is possible, since large disks of homogeneous glass are made elsewhere, expresses his conviction that the proper materials in sufficient purity, are at our command, and that the difficulty is in the mode of effecting perfect combination and vitrification. He proposes to carry the heat of the furnace to the highest practicable degree, thus insuring perfect fusion and fluidity; and then, by maintaining the heat for a considerable time, to give the particles time to arrange themselves in their order of density. He would then lower the heat so gradually as to avoid disturbing their arrangement, but not so slowly as to endanger the vitreous quality. The melting-pots should be cylindrical in form, and as deep as prudence will permit. The mass, when cool, is to be sawn across in parallel slices. In this way, Mr. Nasmyth conceives that disks nearly homogeneous would be procured; and, at any rate, that the density would be uniform through each horizontal section,—which perhaps, would be sufficient for optical purposes. If there be any tendency to unite in definite proportions, it is clear that the circumstances described would favor the combination.

London Athenæum.

Reduction of Silver Ores without Quicksilver.

Two new modes of reducing silver ore have been recently introduced from Germany into Mexico, which promises ere long to supersede entirely the use of that expensive agent, quicksilver. The discoverer is a Mr. Ziervogel. According to the present mode the ore is first calcined with salt, which converts the sulphuret into a chloride; it is then at once removed from the furnace to a suitable tub, or other vessel, and a hot solution of salt poured over it, which immediately takes up the chloride of silver, and holds it in solution; the liquid is then drawn into another vessel, containing metallic copper, when the solution is decomposed, the silver being precipitated, and the liquor, by a simple process, is brought to its original starting point, and may be used over and over again with but little loss of salt. In a second process, the ores, or sulphurets, are carefully roasted in a reverberatory furnace, until they are converted into sulphates, when they are thrown into a suitable vessel, and boiling water poured over them, which immediately dissolves the sulphates; the liquid is then drawn off, and the silver precipitated by the same method as the first process. The latter process is best adapted for ores which contain a large portion of iron and copper pyrites, as a certain quantity of sulphur must be present, to insure the conversion into a sulphate. Mech. Mag.

Observations on Weather Predictions. By M. Arago.

In the *Annuaire* for the present year, presented to the King of the French by the Bureau of Longitudes, M. Arago takes occasion, once for all, to dispose of those weather predictions which annually make the circuit of Europe, falsely stamped with his authority. "Engaged," he says, "both by taste and by duty in meteorological studies, I have frequently been led to consider whether it will ever be possible, by means of astronomical calculations, to determine a year in advance, what in any given place will be the annual temperature, that of each month, the quantity of rain, or the prevailing winds. I have already presented to the readers of the *Annuaire* the results of the enquiries of the natural philosophers and astronomers, concerning the influence of the moon and comets on the changes of the weather. These events demonstrate peremptorily that the lunar and cometary influences are scarcely sensible; and therefore that weather-prophecy can never be a branch of *astronomy, properly so called.* For in fact our satellite and the comets have been at all times considered in meteorology as the preponderating stars. Since those former publications, I have examined the subject in another point of view; I have been enquiring if the labours of men, and events which must always escape our provision, may not have the effect of accidentally and very sensibly modifying climate, as regards temperature, in particular. Already I see that facts will yield me an affirmative answer. I should greatly have preferred to delay the announcement of that result until after the completion of my work; but let me candidly avow, that I have sought to make an occasion *for protesting aloud against those predictions which are yearly made in my name at home and abroad.* No word has ever issued from my mouth, either in the intimacy of private communication or in my discourses delivered during thirty years—no line has ever been published with my assent, which could authorize the attribution to me of any opinion that it is possible, in the present state of our knowledge, to foretell with certainty, what the weather will be, a year, a month, a week, nay, I will say a single day, in advance. I trust only that the annoyance which I have experienced at seeing a host of ridiculous predictions published in my name, may not have led me, by a sort of reaction to give exaggerated importance to the cases of disturbance which I have enumerated. At present, I feel entitled to deduce from the sum of my investigations, this capital conclusion :—*Never, whatever may be the progress of the sciences, will the savant, who is conscientious and careful of his reputation, speculate on a prediction of the weather.*" Naut. Mag.

Manufacture of Water Colors and Black Lead Pencils.

Any improvement or advancement in the fine arts, at all times, has claims to attention ; but where such applies more particularly to the delicacy, yet firmness, of the pencil, and the transparency or opaqueness of colors used in depicting machinery, such has a twofold claim on attention. It is well known that, in the manufacture of water

colors, gum has formed a component part, not only attaching brilliancy to the tone of color, but giving necessary firmness, or compactness, to the cake. It, however, has been found, after much study and attention to the admixture of colors, and their manufacture, that gum might be superseded by the employment of wax—at the same time rendering the colors readily soluble with water, while the tone given nearly approaches an oil painting. One of the main features in this improvement may be said to consist in the power acquired of washing over the color once laid down without the danger to be apprehended from moving or destroying the transparency or brilliancy—a point which those acquainted with the mechanical drawings can well estimate. The testimonials submitted to us, of the importance to be attached to the introduction of wax instead of gum, and now before us, embrace the principal historical and landscape painters of the day, whether in oil or water colors. Messrs. Reeves & Sons have also lately introduced a superior black-lead pencil, manufactured from the dust of pure Cumberland lead—a step taken by them in consequence of the lead mine in Cumberland, from which the supply has heretofore been acquired, having failed to produce the quality, if not the quantity of lead, which has been extracted from it in past days. The importance to be attached to the freedom of handling by the pencil, which depends mainly on the purity of the lead, while they are free from grit, and possess the several varieties of hardness and tint that may be required, forms one of the most prominent claims on attention. Having availed ourselves of the use both of the pencils and colors, we have no hesitation in adding our humble testimony to that rendered by the principal artists of the day. Min. Jour.

AMERICAN PATENTS.

List of American Patents which issued in the month of September, 1845. With Remarks and Exemplifications, by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For improvements in the machine for *Cleaning Grain;* Anthony Cooley, Kalamazoo, Michigan, September 2.

Claim.—"What I claim as my invention is the combination of the cylinder, inclined conical sieve, and fan, substantially as herein described, and for the purpose of cleaning grain.

And I also claim the combination of the cylinder, inclined cylindrical screen, and fan-blower, substantially as described; and also the combination of the cylindrical screen, conical sieve, fan-blower, and cylinder, for the purpose and in the manner described above."

The cylinder is perforated with large holes for the admission of air, and within there is a conical sieve, and between the two a cylindrical screen, all these attached and rotating together, the two latter about half the length of the external cylinder, and beyond the end of the

screen and sieve there is a spiral fan blower to produce a current of air through the apparatus in the direction of the axis, the grain being fed inside the conical sieve at the end opposite the fan blower. The open end of the cylinder where the grain is fed in, is supported and runs on friction rollers.

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2. For an improvement in the *Cultivator;* Almond Harrison, Blissfield, Michigan, September 2.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of securing the cultivator beam to one of the cross pieces of the handles or standards, (upon which it turns,) in combination with the manner of fastening and screwing the same to each other, and regulating the angle of inclination of the handles and cultivating points, and the position of the beam, by means of the adjusting braces and nuts, constructed and operating substantially in the manner and for the purpose herein set forth, and represented in the different modifications of my new and improved shovel-pointed cultivator."

The shovels are attached to the lower end of two standards, which take the place and answer the purpose of handles, and one of the cross pieces that connect these together is round, and passes through the back end of the beam, which is braced to the standards by brace rods that pass through the standards and are provided with adjusting nuts on each side, by means of which the inclination of the beam can be regulated.

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3. For improvements in the *Cultivator;* Andrew Ralston, West Middletown, Pennsylvania, September 2.

The claim refers to, and is wholly dependent on the drawings and therefore we are under the necessity of omitting it. It is limited to the arrangement of parts for adjusting and guiding.

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4. For a machine for *Breaking Coal;* Wm. Richardson, Philadelphia, Pennsylvania, September 2.

The patentee says.—"In my machine, I use a series of wheels of cast iron which are made fast to the same shaft, at a suitable distance from each other. From the peripheries of these wheels project a number of teeth, or cutters, which in the revolution of the wheels are brought into contact with the coal to be broken. The peripheries and cutters of these wheels pass in between bars of iron which constitute a part of the bed on which the coal to be broken is deposited, and which may be denominated the hopper. From the sides of these bars project stationary teeth or cutters which co-operate with the revolving cutters in breaking the coal."

Claim.—"Having thus fully described the nature of my machine for breaking coal, and shown the manner in which the same operates, what I claim therein as new, and desire to secure by letters patent

is the manner, herein made known, in which I form and combine the bars, and the wheels working between them; the bars having the cutters projecting out laterally from them, and the wheels carrying the cutters on their peripheries.

I do not make any claim to the manner of gearing this apparatus, nor do I intend to limit myself to the particular mode of so doing, herein described, but to vary this, as well as the form of other parts, as I may deem proper, whilst I attain the same end by means substantially the same."

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5. For an improvement in the machine for *Exercising Invalids and others requiring Physical Exercise;* James Elliot, Newark, New Jersey, September 2.

This consists of a saddle placed on an elliptical spring attached to a stand, so that the invalid seated on the saddle, can by taking hold of handles attached to the stand, work himself up and down.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is combining a saddle, or other suitable seat and spring, with handles, the whole being mounted on a suitable frame, substantially in the manner described."

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6. For an improvement in the *Graduating Pen Holder;* Daniel Harrington, Philadelphia, Pennsylvania, September 2.

Claim.—"I am aware that slides have been applied to pen and pencil holders, for various purposes, as also projections to receive the ends of the writer's fingers, to protect them from the ink; and therefore I do not claim simply the application of spring slides or projections for the reception and protection of the fingers, as of my invention; but what I do claim therein as new, and desire to secure by letters patent, is the combining therewith a projecting piece, ring, or guard, which shall extend out from the holder sufficiently far to act as a guard in preventing the pen from passing too deep into the ink-holder, such ring or guard being attached to a spring sliding within the body of the pen-holder, to afford the ready means of strengthening the spring and for adjustment, substantially in the manner herein described.

"It will be seen, that, although the sliding part of the pen-holder bears some resemblance to the slide of a pencil-case and of some other instruments, its object and arrangement differ entirely from those of such slides, in its constituting a projecting guard, intended for a new and definite purpose."

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7. For an improvement in the *Door Lock;* George Oates, Charleston, South Carolina, September 2.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is combining the two bolts by means of the dog or lever, so that when the inside bolt has been locked, the outside one cannot be locked, as described."

This lock is made with two bolts, one operated by the key from the outside, and the other by the key inside, so that when the lock is closed inside, access cannot be had from the outside, and to prevent a person inside the room from being locked in, the two bolts are combined by a lever which holds the open bolt to prevent locking when the other is closed.

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8. For an improvement in the *Galvanic Electric Machine;* Daniel Harrington, Philadelphia, Pennsylvania, September 2.

This instrument is for "conveying galvanic electricity (for the cure or alleviation of diseases) into the human system through the different cavities thereof, particularly through the rectum and vagina—and also by the same instrumental process, a new and improved mode of accompanying the galvanic influence by life-giving action in the way of alternate distension and contraction of the parts in quick succession."

Claim.—"The improvements embraced in this new instrument, and for which I ask letters patent, are the method of combining the pieces of copper and zinc into an instrument, said pieces being insulated from each other, and having liberty to rock, so as to touch together, by being moved to the right or left, and thereby produce a galvanic shock: while they are so affected they produce mechanical action—all as above described; by which a much greater number of shocks are experienced in a given time, than the ordinary instrument, in any of its forms, can be made to do, and thereby furnishing a large *increase* of curative or medicinal power. The above named improvements, it will be seen, are three-fold. There is also one other improvement embraced in this instrument, which is important to such invalids as are feeble in the strength of their fingers, which is a usual thing with emaciated females; the shocks produced by moving the turned-up end to the right or left can be accomplished with the least possible exertion of the hand, or thumb and finger.

"It is my intention to vary the construction of the newly improved galvanic electric instrument, so as to adapt it to the requisitions of the various cavities of the human system, and the wants of invalids of all descriptions, still preserving and embracing its general principles, features, and improvements, as above described and claimed; and I do hereby declare that it is *not* my intention to claim anything *herein* that is embraced in my former letters patent."

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9. For improvements in the method of *Raising, or Saving the Cargoes of Wrecked Vessels;* Phineas Bennet, New York city, New York, September 2.

The following claim will be found to give a clear notion of the principles of these improvements.

Claim.—"I do not claim as my invention the employment of a steam or other boat for assisting in saving or partially saving wrecks or other cargoes, as this has before been done; but what I do claim

as my invention, and desire to secure by letters patent, is the employment of a caisson made of water-proof cloth, or other suitable material, rendered water-proof, or partly so, to enclose a wrecked vessel, for the purpose of excluding the surrounding water whilst pumping from the inside of the wreck and caisson, as herein described.

"I also claim as my invention the employment of the movable frame or platform, in combination with the flexible caisson and wreck, for the purpose and in the manner described; and, finally, I claim connecting a pump, or pumps, with the caisson, and a steam engine or other first mover on board a boat, by means of the swinging crane, in combination with the universal joints, as herein described, to admit of the free movement of the boat or caisson, without affecting the connexions, as herein described."

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10. For an improvement in the method of *Preventing the Explosion of Steam Boilers, and Saving Fuel;* James Montgomery, Memphis, Tennessee, September 2.

Claim.—"Having thus fully described the nature of my improvements in the manner of employing expanding bars or rods for preventing explosions and economizing fuel, what I claim as new therein, and desire to secure by letters patent, is the combining with a steam boiler of two such bars of brass or other suitable metal, arranged as herein described; said bars being also combined with each other, and with the apparatus by which the damper in the chimney is to be closed, and the draught through the furnace arrested, the same being effected substantially in the manner herein set forth. I do not intend, however, by this claim, to limit myself to the precise arrangement of the respective parts of my apparatus, as herein described, but to vary them as I may think proper, whilst I attain the same end by means substantially the same.

"I do not claim the exclusive right to use expansion rods or bars to open or close valves or dampers, by variations of temperature, this principle for obtaining motion for such a purpose being well known; but I limit my claim to the foregoing improved arrangement and combination of parts for effecting this object."

Two brass rods are used and inserted in iron tubes, one placed near the bottom of the boiler, and the other at the side and just above the top of the flues, the tubes being attached at each end to the heads of the boiler so that the rods can pass out through the heads. The lower rod is attached to the tube at the forward head, and at the other end is jointed to a lever, the other end of which is jointed to the other rod, the fulcrum being between the two rods—and the other end of the upper rod which moves by the expansion of the two, is connected with the damper by a piston or other means.

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11. For an improvement in the method of *Driving the Spindles or Bobbins of Spinning Machines;* Benjamin Brundred, Paterson, New Jersey, September 2.

Claim.—"Having thus fully described the nature of my improve-

ment in the manner of driving the bobbins, spindles, and flyers of a throstle, for the spinning of cotton or other fibrous substances, what I claim therein as new, and desire to secure by letters patent, is the giving motion to such bobbins, spindles, and flyers, by means of a horizontal friction wheel, bevelled on its upper edge, so as to adapt it to the lower ends of the flanches of the bobbins, or some analogous device on the spindles, which are also duly bevelled; by which means I am enabled to give them the requisite motion, and to dispense with the use of bands for that purpose.

"I do not claim to be the inventor of the method of communicating a revolving motion from one body to another, by means of friction, this having been frequently done in machinery of various kinds: but I do claim the manner of applying this principle to the driving of the bobbins or spindles of a throstle, or other similar spinning machine, under an arrangement of the respective parts, and for the purpose herein fully made known; by means of which arrangement and combination the use of bands is dispensed with, and the motion is more advantageously communicated than in the ordinary mode, whilst the revolving and traversing motions necessary to the winding up of the yarn upon the spools are given thereto."

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12. For an improvement in the machine for *Drilling Rocks, &c.;* Hiram H. Scoville, for himself, and as joint inventor with William Avery, deceased, Desplaines, Illinois, September 2.

Claim.—"What I claim as my invention, (jointly with the late William Avery,) and which I desire to secure by letters patent, is the before described construction of the jaws for griping and raising the drill, in combination with the drill and winding ways for turning it, and the manner of closing the jaws by means of the aforesaid combination of the arm *u*, axle *c*, arm *g*, rod *h*, lever and cam, or any other combination substantially the same, for a similar purpose."

The rod of the drill is drawn up and turned partly round at each operation by means of a pair of jaws that slide up and down by a crank motion, they gripe the rod at the bottom and liberate at top, and the ways on which they slide being winding, they necessarily turn the rod. That part of the claim which refers to the closing of the jaws, could not be made clear without drawings.

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13. For an improvement in the *Propeller;* John Ericsson, New York City, New York, September 9.

Claim.—"Now I do not claim, as my invention, the application to purposes of propulsion of spiral blades, radiating from and fastened to a centre block or hub, letters patent for the same having been issued, in the United States, to Benjamin M. Smith, in 1829; but I claim as my invention, and desire to secure by letters patent, the hub, constructed with the perforated projections, and the combination of the same with the elliptic braces, for the purpose of sustaining and strengthening the spiral propeller blades, as herein before described."

The projections from the hub to which the blades are attached are made hollow for the passage of the water in the direction of the plane of the face to which the blade is attached. And the elliptic braces are segments of hoops made oblique to the axis, and therefore elliptical—they are used to brace together the blades about midway between the hub and tips.

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14. For improvements in the *Rotary Steam Engine;* William Wright, Rochester, New York, September 9.

The patentee says:—"The nature of my invention consists in arranging a cutter, which, as it rotates with the shaft to cut out the annular grooves, receives a slow rotary motion on the arm or flanch which connects it with the shaft to make the groove a true circle in its cross section."

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15. For an improvement in the machine for *Moulding Bricks;* William Sandford, Cambridge, Massachusetts, September 9.

Claim.—"Having thus described my invention, I shall claim the combination with the clay or mortar hopper, or reservoir, and one or both its chambers, discharging vents, or false moulds and pistons, of the reciprocating slide arranged within the hopper and upon its bottom, and operating to supply the end chambers and vents with mortar or clay, substantially as above described."

On each side of the hopper for mixing the clay there is a chamber, into which the mixed clay passes, the bottom of these chambers is provided with a grating or vents, through which the clay is forced into the moulds, carried below on a slide, by means of pistons working vertically in the chamber.

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16. For an improvement in the *Cooking Stove;* C. J. Woolson, Cleveland, Ohio, September 9.

Claim.—"Having thus fully described the nature of my improvement in the manner of communicating heat to the ovens of cooking stoves, I do hereby declare that I do not claim any improvement in the general construction of stoves, my improvement in the lower oven flue being equally applicable to stoves in a variety of forms: but what I do claim as my invention, and desire to secure by letters patent, is the forming of the bottom plate of the oven with a number of tubes or boxes, usually of sheet iron or other substance, thinner than the bottom plate, that descend from it through the lower flue space; the same being effected under an arrangement of their respective parts substantially the same with that herein described, and for the purpose set forth."

The object of making the bottom plate of the oven in this manner is to heat the air in the tubes, which passes from them into the oven to aid in baking.

17. For an improvement in *Extension Tables;* Cornelius Briggs, Roxbury, Massachusetts, September 9.

Claim.—"Having thus described my improvement in "extension tables," I shall state my claim as follows: What I claim as my invention, and desire to have secured to me by letters patent, is the making or arranging either semicircular part of the top of said tables so as to be capable of a horizontal adjustment, substantially as herein above described, and for the purpose set forth."

The semicircular parts of the table are liable to shrink from the frame to which they are attached, so that put together to be used as a centre table, the two semicircular tops do not come together. Under this improvement, the top is connected with the frame by means of right angle cleats attached to the frame and sliding in metallic grooved pieces attached to the top, and a screw passes through a nut attached to the under side of the table and bears against the semicircular part of the frame, the turning of which effects the adjustment.

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18. For improvements in the *Hill-Side Plough;* Joseph Trump, Connellsville, Pennsylvania, September 9.

We are under the necessity of omitting the claims in this case, as they refer to, and are wholly dependent on, the drawings. It is for alleged improvements in the well known hill side plough which consists of two ploughs cast heel to heel, and connected with the beam by means of a bolt and latch so that the beam and team can be turned at the end of each furrow without turning the plough. The claim is limited to the combination of minute parts employed in this connexion of the beam and plough, and for the arrangement of the latch.

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19. For improvements in the *Machine for Folding Sheet Metal;* Henry A. Roe, Erie, Pennsylvania, September 11.

The patentee says:—"The nature of my invention consists, first, in attaching what I term the folding plate, that is to say, a plate which gripes the edge of the sheet of metal, and on which the folding is effected by the folder, to a bed placed below it and hinged to the bed of the machine, so that the sheet of metal can be folded entirely over, instead of griping the sheet by a square jaw extending above and forming a stock above the plane of the bed of the machine, as heretofore, which prevents the sheet from being folded entirely over, and therefore requiring a secondary operation to complete the folds.

"Secondly: In supporting the said folding bed, to which the folding plate is attached, in the middle of its length by a joint bolt, the head of which lies in a semi-circular recess in the folding bed and as near as practicable in a line with the axis of motion, and secured in the bed of the machine.

"And thirdly, In the employment of a side plate below the folding bed and back of its journals, provided with inclined planes on which projections from the back of the folding bed rest, so that by the work-

ing of the slide plate by a lever at the end of the machine, the folding plate can be made to gripe and liberate the sheet of metal."

Claim.—"I do not claim as my invention simply griping the sheet of metal between the face of a stock and the bed, as this has heretofore been done; but what I do claim as my invention, and desire to secure by letters patent, is, first, making the folding plate to project from and on top of the stocks to which it is attached, or of which it makes part, arranged in combination with the bed of the machine and the folder, in the manner herein described, by means of which the edge of the sheet metal is griped and folded entirely over, substantially as herein described; and I also claim, in combination with this arrangement, the manner of preventing the folding bed and folding plate from springing in the middle of the length, by means of the bolt, with its imbedded journal head, substantially as herein described."

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20. For an improvement in *Stoves;* Benjamin T. Roney, Attleborough, Pennsylvania, September 11.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined the coal-fire chamber with the wood-fire chamber, by placing the grate of the coal chamber partly within the top of the wood chamber, and in combination therewith the fluted form of the coal-fire chamber, to admit a draught from the wood-fire to pass through the coal chamber, as herein fully expressed."

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21. For a method of *Preventing and Removing Incrustations in Steam Boilers;* Louis A. Ritterbandt, Poland, September 11.—Date of foreign patent Dec. 2nd, 1844.

Claim.—"And having now described the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is, first, the application of ammoniacal salts, in the manner before described, to prevent and remove incrustation in the steam boilers and steam generators; and, secondly, the use of ammoniacal salts in *conjunction* with muriatic, acetic, or nitric acid, for the purpose of removing old incrustation, in the manner above described."

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22. For an improvement in the *Wind Mill;* George Parker, Corinna, Maine, September 11.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the mode of regulating the speed of the mill by means of the fixed and movable rudders, roller, cord, and weight, in combination with the circular platform to which they are attached, containing the wind wheel and axle, and resting on friction rollers, in the manner set forth."

This wind mill is of the usual construction, with the wings on the end of a horizontal shaft. The turning platform at the top is provided with two "rudders," placed radially on each side of the shaft, one

permanently attached, the other jointed and kept in radial position by a weighted cord passing over a pulley so that, when the wind is too strong, this weight is overcome, giving the preponderance to the other rudder, which throws the wings out of the proper line for the action of the wind, to reduce the speed.

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23. For improvements in the *Parlor Grate;* James Wilson, New York City, New York, September 13.

This is for an arrangement of a chamber for heated air, in connexion with the pipes and dampers for regulating its circulation; but as the claim refers to, and is wholly dependent on the drawings, we are under the necessity of omitting it.

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24. For an improved method of making *Dye-Stuff or Carasene from spent madder;* Frederick Pfauner, Providence, Rhode Island, September 13.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of making the dye-stuff or carasene from spent madder, by the chemical action of water, sulphuric acid, and an alkali, as described above."

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25. For an improvement in the *Propeller;* Leonard Phleger, Wilmington, Delaware, September 13.

Claim.—"I do not claim merely covering the wings of the propeller in such a manner that a section perpendicular to the shaft would produce a curved line, nor do I claim making the wings approximating to the form of a conical surface; but what I do claim as my invention, and desire to secure by letters patent, is making the wings of the propeller in the precise form of such a portion of the convex surface of a regular cone as would be cut out by a plane or planes passing through its axis, and comprehending about half of its surface, each wing being attached, along one of its straight edges, to the shaft."

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26. For an improved *Instrument for Boring Earth;* Thomas L. Speakman and Richard A. Stratton, Philadelphia, Pennsylvania, September 17.

This instrument consists of a tubular shaft, at the lower end of which are jointed the cutters, so made that they can be drawn into recesses in the tube, or expanded out after the instrument has been introduced. The ends of the jointed cutters are connected by wires with a slide or handle at the upper end of the tube, for the purpose of opening or closing them.

Claim.—"Having thus fully described the nature of our improved apparatus for enlarging or forming chambers within the openings made by boring the earth or rocks, what we claim therein as new, and desire to secure by letters patent, is the manner of constructing an in-

strument such as is herein described and represented, in which expanding cutters are so combined with a tubular shaft as that they may be received within it, and be made to open out by an arrangement of parts constructed for that purpose, and substantially in the manner herein set forth."

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27. For improvements in the *Mortising Machine;* Charles Bennett, Pepperell, Massachusetts, September 17.

Claim.—"In conclusion, I claim the combination of the chisel carriage with a separate carriage; arranged to operate in the manner and for the purpose above specified.

"Also, the combination of the slide cam on the chisel holder, arms, and straps; the whole being applied to the chisel holder, its carriage, and the carriage A, and operating substantially in the manner and for the purpose as hereinbefore described."

The chisel carriage, (A,) slides in ways attached to another carriage, (B,) in which are the bearings of the crank shaft, so that the chisel can be set to any thickness of stuff. The other part of the claim we could not make clear without the drawings, and as it relates simply to the turning of the chisel at the end of the mortise, we deem it unnecessary to insert the drawings.

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28. For an improvement in the *Brush for Saw Gins;* Edwin Keith, Bridgewater, Massachusetts, September 19.

Claim.—"I claim as my invention, and ask a patent for, a cotton gin brush, made of a cylindrical form, with holes or openings as above described; or made with pieces of lagging, with open spaces between them, as above described; also, with openings at the ends about the axis of the shaft, as above described, and with heads, the outer ones having each a hoop, circular projection, or other equivalent contrivance, for cutting off currents and eddies of air, as above described.

"I also claim as my invention, and ask a patent for, the hoop, circular projection, or other equivalent contrivance, at the head of the brush, for cutting off currents and eddies of air, as above described, with an opening within the hoop or circular projection for the admission of air, as above described.

"The object of my improvement is to take the cotton from the saw teeth in minute quantities with the fibres free and separated, and in all states of the atmosphere, to supply a constant and uniform current of air into the cotton-room, so that the cotton may be delivered into it in the same free and open state in which it is taken from the saws by the brush, and more free from motes and dirt than heretofore—and to prevent the cotton from dropping or lodging in front of the moteboard or in any part of the flue; and these objects my brush is found to effect successfully."

(To be continued.)

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OCTOBER, 1846.

CIVIL ENGINEERING.

Extracts from the Report of Napoleon Garella, *an Engineer appointed by the French Government to survey the Isthmus of Panama. Translated for the Journal of the Franklin Institute by* Persifor Frazer, Esq.

(Continued from page 154.)

Estimate of the Expenses of Constructing the Canal.

I will not enter here into the details of the calculations which have served me in estimating approximatively the cost of construction of the canal which I propose. It will be sufficient to make known their results, as well as the principal bases on which they are founded.

Of these, the price of labor is undoubtedly the most essential, and at the same time the most difficult to estimate exactly; in the isthmus, where there are no public works, we meet with nothing from which to draw a comparison, unless it is the wages of a few masons and carpenters, who, on account of their limited number and the scarcity of work, are paid at a very high rate. We must not expect, therefore, to find in the country any of the artisans, such as masons, carpenters, smiths, &c., that will be required in the execution of the work; neither will we find laborers accustomed to the handling of tools, but, as for this the apprenticeship will be neither long nor difficult, we may count on the country and the adjoining ones to furnish the necessary force, which may be readily instructed in their work. The workmen whom I have had occasion to employ in my explora-

tions in the isthmus, to open paths, and to clear the line followed by the levelings, were paid from 2½ to 3 reals per day, besides their nourishment, which amounted to ½ or ¾ of a real more. 4 reals (2 francs 50 cen.) will then represent the maximum of their wages. In my estimates I have taken this base as the minimum of the wages of a laborer, and have put at 3 francs that of the workmen to be employed in excavating, &c., whom it will be necessary to instruct in their work. This, however, is the only element I have drawn from the ordinary prices of the country; the other wages I have based upon similar ones in France, augmenting them 50 per cent.,—thus I have raised those of carpenters and stone cutters to 7f. 50 cent. a day; those of masons, quarrymen, smiths, &c. to 5 francs, and so for the rest.

Starting from these bases, I have arrived at the following estimates:

Art i.—*Excavations, Embankments, &c.*

1st. Summit Level—Length 7730 metres.

	Metres.	Cubic met.		Fr's. cent.	Fr's. cent.	Francs. cent.
Tunnel, length,	5350		at	6,700·00		35,845,000·00
South deep cut,	1570	816,729 600 in rock,	"	7 62	6,223 479·55	10,307,114·33
North " "	810	543 759,625 "	"	7 51	4,083,634 78	
Total,	7730					46,152,114·33

2nd. Pacific Slope—Length 13,450 metres.

	Cubic metres.	Fr's. ct.	Fr's. ct.	Fr's. ct.	
Excavations,	1,928 413 851 in earth,	at 1 16 av. price.		2,244,749·96	
Embankments,	711,298,800 from cuttings.	" 0 25	177 824 70		
	1,453,721,500 fm. side cuttings	" 1·38	2,047,535·68		
				2 225,360·38	
					4,470,110·34

3d. Atlantic Slope—Length 33,650 metres.

	Cubic metres.	Fr's. ct.	Fr's. ct.	Fr's. ct.	
Excavations,	350 000 000 in rock,	at 7·58	2,653,000 00		
	5,736,558 606 in earth,	" 1·22	7,437 980 10		
				10,090,980·10	
Embankments,	4 502 632 113 fm. cuttings,	at 0 25	1.125 658·03		
	678 991,575 fm. side do.	" 1 58	937,008 37		
				2 062 666·40	
					12,153,646·40

Total for the Canal between the Pacific and the Rio Chagres at Dos Hermanos, 62,775,871·17

4th. Canal from the Bay of Limon to Rio Chagres.

	Cub. met.		Fr's ct..	Fr's. cent.	
Excavations in earth,	6,693,907,500	at	1 94	12,986.180·55	
	698 002,500	"	1·19	830 664·87	
Dredging,	240,831,670	"	3·63	874,218·96	
					14,691,034·38

5th. Rectification of the Rio Chagres.

Excavation of canal for a length of 4,140 metres, at a mean depth of 10 metres—section of 385·20 sq. metres.

	Cub. met.		Fr's. ct.	Fr's. cent.	
Excavation,	1 594,728	at	1·15	1,834,537·20	

Deepening the bed of the river for a length of 5170 metres, 90 metres cube per metre to be raised by steam dredging.

	Cub met.		Fr's.	Fr's. cent.	
Dredging,	465,300	at	2	930,600·00	
Tow path,	5,170	"	20 per metre,	103,400 00	
			Total		2,868,537·20

Amount carried forward, 80,335,442·75

Amount brought forward,	80,335,442·75

6th. Feeders—length 100,000 metres.

Estimated at 25 francs per metre, comprising draws, bridges &c.,	2,500,000·00
Total of excavations, embankments, &c.,	82,835,442·75

Art. II.—*Constructions.*

		Fr's. ct.	
36 locks	at 600 000 francs each,	21 600,000·00	
3 large aqueducts,	" 265 000 francs,	795,000·00	
3 small "	" 75,000 francs,	225,000 00	
			22,620,000 00

Art. III.—*Ports at the extremities of the Canal.*

1st. Port of Limon on the Atlantic.

	Fr's. ct.
Mole of 1000 metres in length; mean depth of water 6 metres; mean section 456·70 cubic metres.	4,085,050·00
Dredging over a surface of 1,000,000 square metres to a mean depth of 2·50 metres—2,500,000 cubic metres at 2 francs,	5 000,000 00
Total,	9,085,050·00

2nd. Port of Vaca di Monte on the Pacific.

Two jettys 600 metres each in length; mean depth of water 6 metres, mean section 432 75 square metres,	4,525,894·40	
Dredging over a surface of 280,000 square metres; mean depth 3 metres—840,000 cubic metres at 2 francs,	1,680 000 00	
Total,	6 205,894·40	
Total for both ports,		15,290,944·40
For roads, houses of employees, &c.,		3 253 611 85
Grand total,		125,000,000 00

In this estimate, which amounts to 125 millions of francs, (under 25 millions of dollars,) I have not included the arching (revêtement) of the tunnel, which the consistent and compact nature of the rock through which it is to be cut will probably render unnecessary. Should it be otherwise, its execution would increase considerably the sum of the expenses. The arch, in brick, 1 metre thick, would cost, at the prices laid down for the rest of the work, 2600 francs per metre in length—which would be, for the whole, 13,910,000 francs, and would elevate the whole cost to 139 millions. But I repeat that I do not think it will be necessary, or if so, only to a small extent. For this reason I have not taken it into the estimate. At all events, to cover all possible chances, it will be sufficient to increase the estimate by 5 millions, making the probable expense 130 millions of francs.

This valuation is on the supposition that the summit-level is to be established by means of a tunnel. In the case of a deep cut whose bed would be 15 metres higher than that of the tunnel, the expense would be considerably greater, both on account of the increased number of locks and the cube of excavation. In making the summit-level, by means of a deep cut of 84 metres in maximum depth, the additional expense would be about 19 millions, and, consequently, the whole expense 149 millions of francs.

We may see by this, that the project with a tunnel offers, over that with a deep cut, beside the advantages of a more easy and certain supply of water and a shorter navigation, that very important one of

a considerable diminution of expense. It would not be impossible, in raising the summit-level, to diminish the cost; but the economy would be at the sacrifice of the excellence of the line, and the advantages to be obtained from the canal.

The object of the mission with which I was charged, was to ascertain the possibility of the construction of a canal across the isthmus, and to arrive at an approximative estimate of the cost of such a work. I have not, therefore, the pretension of offering a complete project, and still less of indicating the best line to follow. A more profound and detailed examination than that I was enabled to make during the short period I passed in the isthmus, might result in the discovery of more suitable points of passage of the chain, and thereby diminish the estimate of expense. My labor will not the less have fulfilled the object I had in view, which was to prove the possibility of the junction of the two oceans, and to fix a maximum evaluation of expenses, which may be diminished by the discovery of a better line.

Probable Revenue of the Canal.

The revenue of the canal will be derived principally from the tolls taken from vessels passing through it. It is, therefore, proper to inquire what are the vessels likely to take this route.

From the tables prepared by the Minister of Commerce, the number of vessels belonging to the four great maritime powers, France, England, Holland, and the United States, which doubled the two capes, Horn and Good Hope, in the year 1841, amounts to 2966, with an united tonnage of 1,203,762 (being a mean tonnage of 405 per ship.) Of this number, it is difficult to know exactly what ships went by Cape Horn, and which doubled the Cape of Good Hope. But in taking as a base the division of the countries, we may establish the distinction approximatively. Thus, in giving to Cape Horn all the countries situated to the eastward of the Dutch East Indies, Sumatra, and the Isles of Sunda, and to the Cape of Good Hope those which are between Sunda and the eastern Coast of Africa, we have,

For Cape Horn,	1567	ships of	636,462 tons.
For the Cape of Good Hope,	1399	"	567,300 "
Total,	2966		1,203,762

This estimate is purely conjectural, and appears, in the actual state of things, to accord too much to the navigation by Cape Horn. But we may suppose that, were the isthmus of Panama cut through, the division would be more exact, and that in that case all the ships going to the eastward of Sunda, and even those going to Batavia, would adopt the last route. Instead of diminishing the estimated number, I think there would be reason for augmenting it. The tables of the Minister of Commerce take no account of the vessels of Spain, Russia, Sardinia, &c., nor of the movement resulting from the relations of Europe and the United States with the western coast of America, which itself may be estimated at, at least, 60,000 tons. If, again, we

remark the steady increase shown in the movement of commerce for the three years, 1839–40–41, which we may reasonably suppose to have been continued up to the present moment, we can, without fear of error, put down the sum of 700,000 tons, as a probable basis, from which we may rationally calculate the revenues of the canal: this sum expressing the passage which we may look for in the actual state of commercial relations, and not that still more considerable on which we have a right to count for the future, when these relations shall have been augmented, by the opening of a new route which, by abridging distances, will render voyages easier and less dangerous.

There remains now to be determined the rate of tolls to be charged on vessels traversing the isthmus. At first sight it appears natural to take as a base for the tariff the tonnage of vessels, and to establish it proportional to the volume of their cargo; that is, what has hitherto been proposed by those who have paid attention to this question. The government of New Grenada, which accorded the privilege of cutting the isthmus to the Salomon Company, left to this last the power of fixing the toll, with the sole condition that it should be the same for all nations. For my part, whilst I agree that the amount of tonnage should serve as a base for the tariff, it appears to me that the expense occasioned by the passage of vessels may be divided into two portions, of which one, destined to cover the interest of the capital employed in the construction, should be borne by vessels in proportion to their size and the importance of the advantages they derive from the establishment of this new route, and, consequently, it should be in proportion to their tonnage; as for the other portion of the expense occasioned by the passage of the locks, which demands the same labor and the same consumption of water, whatever may be the size of the ship, it should be fixed, and the same for all vessels.

We may suppose that the opening of the isthmus will make a mean diminution of at least a month in the length of the voyage of ships which take this route; the economy resulting to the owners may then be approximately valued, for a ship of 300 tons, as follows:—

Wages of officers and crew, provisions, &c.,	3000	
Interest at 1½ per cent. on the value of the cargo, say 100,000 francs,	500*	
Interest at 1 per cent. on the value of the ship, say 90,000 francs,	900	
Total of monthly expenses,	4400	(5400)
Difference of insurance of 1 per cent. on the united value of cargo and ship,	1900	
Total,	6300	(7300)

In dividing equally this saving between the company and the ship, it would be 3,150 francs (3,650) that the ship must pay to the com-

* This should be 1,500; the error affects the whole calculation.

pany, or 10 francs (12·16) per ton. In admitting, to a certain extent the principles laid down above, of the division of the expense into two portions, I would propose to fix the tariff of tolls as follows:—

For vessels of 300 tons and upwards, 10 fr's. per ton.
" under 300 tons, a fixed toll of 1500 fr's., and 5 fr's. per ton.

It may be objected that this tariff will be more onerous on small vessels than on large ones, to this I would reply that it not only appears to me fixed on a more just principle, but that it is precisely small vessels which would not risk the long voyages across the two oceans, and would make, in preference, from the United States and the West Indies, voyages along the coast to Chili, Peru, western Mexico, and the Oregon Territory, and which, consequently, having a greater interest in the opening of the isthmus, can afford to pay a little dearer for the advantage of being able to follow this new route.

To resume, we may then admit a minimum gross revenue of 10 francs per ton, or 7 millions of francs for the 700,000 tons which would pass through the canal.

From this sum, we must deduct the expenses for repairs, and of the administration of the canal, which may be estimated at 6000 francs per kilometre, (about $1824 per mile,) in taking as a base the valuations admitted in France, to wit:—1100 francs per kilometre for repairs, and 1500 francs for expenses of administration, together 2600 francs. The annual expense of the 76,500 metres of the line of navigation would then be 459,000 francs, which I will call 500,000 ($94,-000,) to cover any difference, the nett revenue would then be reduced to 6,500,000 francs, exactly 5 per cent. on the expense of construction as estimated at 130 millions, for the project with a tunnel at the summit-level. To this principal source of revenue may be added the sale or improvement of the immense extent of land which the government of Bogota conceded to the Salomon Company in granting them the privilege of the route across the isthmus. Although this concession has been annulled by a posterior decree, founded on the non-performance of the conditions imposed by the government and accepted by the Company, there is reason to hope, indeed it is certain, that the same, or even greater advantages would be accorded to a Company who would seriously offer themselves with sufficient guarantees for the construction of the canal of Panama. I have not, however, regarded these advantages, on which we may count as certain, except in not having allowed in the estimate any thing for the acquisition of land, which, for the most part will be accorded gratuitously by the State, and of which the small portion belonging to individual proprietors will have a value much inferior to those conceded to the Company off the line of the canal.

In the proposition for a tariff of tolls, I have left to the charge of the vessels themselves the expenses of traction. These expenses will be very inferior to the dues to the canal. In France they are estimated at a mean price of ·05 centimes the ton per kilometre, at a rate of from 80 to 100 metres per minute. In adopting this price, and it certainly would not be greater in the isthmus, where horses and mules

cost but little, and where forage is easily obtained and cheap, the towing a ton across the line would cost 3·825 francs, and a ship of 300 tons 1147·50 francs.

At the rate of 80 metres per minute, the whole line would be passed over in - -	16 hours.
To which must be added the time for passing the locks, 36 at 15 minutes each, - -	9 "
Total,	25 "

Or 2 days, supposing the service of the canal to be performed only by daylight.

Execution of the Work.

The three great maritime powers most interested in opening the route across the isthmus, are France, England, and the United States. A treaty passed between them guaranteeing the neutrality of the passage of the isthmus, will be sufficient to insure the free and quiet possession of the passage against the attacks of any other power, or even against one of the contracting parties themselves. The accession of the other powers interested, such as Holland, Spain, Russia, Sardinia, &c., will augment its validity, and serve as a bond to attach them to peace, and render more difficult a general war, which civilization should tend to render impossible. France and England, in uniting to secure the execution of the work, might guarantee also, to the capital engaged in the enterprize, a minimum interest, until the moment when the circulation of the canal should be sufficiently great to render this guarantee useless. An interest of 3 per cent., it appears to me, would be sufficient, particularly when guaranteed by two governments such as France and England. These governments, in thus intervening directly in the execution of the work, and aiding it with their proper means, would acquire, by that act, the right of arbitrating between the government of New Grenada and the Company charged with the execution, of supporting any just demands the Company might have to make on the first, and of insisting with the last on the vigorous execution of all the conditions imposed, and the accomplishment of all promises made, and of overseeing their execution.

One of the first works to be accomplished, as soon as the line of the canal and the situation of the locks shall be decided on, is a road which, following the line for its whole length, will facilitate the transport, to any point, of workmen, materials, provisions, &c. Such a road may be made at an expense of from 1,000,000 to 12,000,000 francs.

The execution of a great canal between the two oceans, such as I propose, will require the simultaneous concourse of a great number of workmen, the greater because the continuation of the rains during nearly six months of the year, from June to November, renders, during that season, all work in the open air impossible; in the supposition that the work is to be accomplished in ten years, it would not

require less than 5000 laborers, 1200 miners, 200 masons, 100 stone cutters, 100 brickmakers, 100 quarrymen, 50 carpenters, in all, 6750 workmen; to which must be added 3 vessels for dredging, and their crews, of which one would be stationed on the Pacific, and two on the Atlantic.

The uniting so large a number of workmen in a country so thinly populated, whose inhabitants are completely ignorant as regards the execution of public works, will certainly be one of the greatest difficulties of this enterprize; this difficulty will be augmented by the heat of the climate, and the insalubrity which is generally, though somewhat erroneously, attributed to it. The yellow fever, that cruel disease, so much dreaded by Europeans who come to the Gulf of Mexico, does not exist in the isthmus of Panama. Chagres, which is always represented as a "pest-house, as horrible to see as it is dangerous to inhabit," is the only really unhealthy place of the isthmus, and what has been said of that has been greatly exaggerated. Its insalubrity which exists only in the rainy season, more especially from July to October, displays itself in remittent fevers, and is due to the presence of stagnant waters, for the draining of which nothing has been done. Moreover, Chagres is avoided in the route I propose, and there is nothing on the borders of the bay of Limon, where the entrance of the canal will be placed, to occasion the slightest uneasiness. As for the interior of the isthmus, I can affirm, that in all my numerous explorations of it, made, it is true, during the dry season, I have seen nothing to authorize a charge of insalubrity. Some large swamps are found on the borders of the Rio Trinidad, but they are a long distance from the line of navigation, which does not cross any one of them, and there is no reason to fear that the canal between the two oceans is to be made only at the sacrifice of the lives of thousands of human victims, or that, when once made, it may not be traversed without danger to life or health. In a word, the climate is not such as to inspire dread to emigrant workmen. A few simple precautions will be sufficient to protect them from the influence of the elevated temperature. Nevertheless, it does not appear to me prudent to expose European workmen, without shelter, to the action of the burning sun of the isthmus, and the successive influences of heat and humidity, two principal causes which, united, often produce fevers. One of the conditions of the execution of the canal should therefore be to employ in the work of excavating and embanking (terrassements) but the laborers of the country, or at all events, those already acclimated to these high temperatures, and to bring them either from the isthmus itself, from the neighboring small republics, or even from the southern part of the United States. It will be sufficient to put over them a certain number of Europeans, as master workmen or guides. One advantage of this measure will be the power of sending these laborers to their homes during the rainy season, when working in the open air is impossible.

All the workmen whose employment demands an apprenticeship, such as masons, carpenters, &c., must be brought from Europe or from the United States. These, it will neither be difficult nor expensive to shelter from the sun and rain, under vast sheds, tents, or even under

portative roofs. It is with a view to such an emigration, that I have placed the wages of these workmen much higher than they receive in France. These wages ought to be sufficient to draw them, as the climate, as I have already said, is far from being as bad as it has been hitherto represented, and much less fatal than that of the Antilles. To favor, moreover, this emigration of workmen, they might be offered a temptation that has in general a great effect on men accustomed to live in society, that of landed property. It would be sufficient to accord to them a certain extent of land, from that conceded by the government, and to increase the allowance in proportion as the length of time they continue in the service of the Company increases. I do not doubt, but that a great number of workmen, having thus become landowners, would decide to continue to inhabit the isthmus, even after the canal shall have been finished, and would thus form the nucleus of an active and laborious population, who would, in a little time, change entirely the face of the country.

The sparseness of the population of the isthmus, and the almost entire absence of culture, which is of very limited extent, especially in the portion of the isthmus where the line will run, a portion almost entirely covered with vast forests, has led to the idea that there would not be found sufficient resources for provisioning the large number of laborers who would be suddenly brought there. This fear, though apparently well founded, is not so in reality. The fertility of the soil of the isthmus is indeed remarkable, and eight months would be more than sufficient to cover ground now occupied by almost impenetrable forests, with magnificent fields of rice, Indian corn, bananas, sugar cane, &c. Certain cantons of the provinces of Panama and Veragua, situated to the westward, possess vast savannahs, where numerous herds of cattle feed, which are often killed merely for their hides. If we add to these the hogs, which are also found in great numbers, we will have every thing that is necessary for the nourishment of the people of the country. For the workmen from Europe and the United States, we must add wine, which will be brought from France, and flour, which will be furnished by the northern States. For these provisions, the former decree of this government granted an entrance free of duty, and certainly the same privilege will be stipulated for in favor of a Company presenting itself with the support of France and England.

The Gauge Commission.

Analysis of Evidence given before the Royal Commissioners appointed to investigate the subject of the diversity of Railway Gauges.

Robert Stephenson, Esq.: Witness's father, Mr. George Stephenson, was chief engineer of the Manchester and Liverpool Railway, completed in 1830. The gauge of 4 feet 8½ inches was adopted by his father, as it was the original gauge of the railways about Newcastle. The Manchester and Liverpool was the first line in this country worked by locomotive engines. After the Liverpool and

Manchester had been established, it was considered imperative that all the lines in that neighborhood should be of the same gauge.

It is difficult to say where a break of gauge in the northern lines could have been made with the least inconvenience, as it involves the question where is the line of minimum traffic. When traveling on the Manchester and Liverpool railway, before laying the gauge of the London and Birmingham, it appeared to witness, as an engine-builder, when called upon to construct engines of greater power, that an increase of three or four inches in the gauge would have assisted him materially, but since, the improvements in the mechanism of the engines have rendered that increase quite unnecessary; they have ample space and to spare. In the arrangement of the machinery, which is the main question, having reference to the width, the working gear has been much simplified, and the communications in the most recent engines between the eccentric and the slide valve have been made direct communications; whereas, formerly, it was made through the intervention of a series of levers which occupied the width. With reference to the increase of power, the size of the boiler is, in point of fact, the only limit to the power, and they have been increased in length on the narrow gauge; the power is increased by increasing their length both in the fire-box and in the tubes; in fact, the power of the engine, supposing the power to be absorbed, may be taken to be directly as the area of the fire-grate or the quantity of fuel contained in the fire-box. No inconvenience results from lengthening the engines to their present extent, and their steadiness is increased; they are at present 12 feet between the front and hind axles. The increase of length between the axles renders the engines less liable to get off the rails; the short engines on four wheels were liable to violent oscillation when meeting any inequality, the front wheels being sometimes actually lifted off the rail; believes the accidents on the Brighton line and on the Brentwood inclined plane were attributable to this pitching motion. The thickness of the crank of the original engine on the Manchester and Liverpool was 3½ inches. There were various plans of reversing the engine at that time. Every engineer, in fact, at that time, had his own plan; some were extremely complicated, requiring time for the reversing to be effected; they moved, in fact, the eccentric. For a long time they moved the eccentric, which slipped upon an axis, and thereby moved the eccentric from one side of the axle to the other, and consequently reversed the engine; but it required a lateral motion of something like 3½ inches; and there being two eccentrics, of course, the mere act of changing the gear occupied 6 or 7 inches of the axle, independent of the more bulky construction of the apparatus itself. The long engines, if kept within 12 feet, are not more likely to get off the rails at curves than short ones.

The resistance in passing round curves is materially affected by the width of the gauge. In the collieries about Newcastle, where the 4 feet 8½ gauge prevails, wherever they come to any mining operations where the power to be used is that of a horse, or a man, they immediately reduce their gauge, because they want to go out and in

amongst the mines with very sharp curves, and the wide gauge would be quite impracticable amongst those. In fact, the small carriages that are used in the mining operations, are upon a gauge of about 20 inches, and they go round curves under ground of about 10 or 12 feet radius; and they could only work such mines by such a gauge. It is quite obvious that the width of gauge must limit the curve. In the case of every gauge at a sharp curve, the outside and inside rail are quite brightened by the sliding motion, because the one set of wheels has to slide forward to keep pace with the other, and the others have to slide backward. In fact, when going round a curve, both operations have to take place,—the sliding backward of the one set and the sliding forward of the other. Of course, as you increase the width of the gauge, the difference between the two becomes augmented.

Is chief engineer of the Northern and Eastern Railway, and was at its construction. Adopted the 5-feet gauge in consequence of its being brought into connection with the Eastern Counties line, which had been laid down with that gauge by Mr. Braithwaite, and with the same view he laid down the 5-feet gauge on the Blackwall, in case there should be connexion between them hereafter. The gauge of the Northern and Eastern and Eastern Counties lines has recently been altered under his direction; when the extension of the Northern and Eastern was considered, and that junction with the narrow lines in the Midlands would take place, a change was thought absolutely necessary, and the same change was also decided on for the Eastern Counties, from the inconvenience of blending two gauges at the Shoreditch station; the expense of a separate carrying establishment would have been greater than the cost of alteration, which was £52,000. Of course it involved the necessity of working upon a single line of rails; the establishment was divided into two parts, one of which was retained as available for the 5-feet gauge, whilst the other half was altered to be ready to work upon the other line, which had been converted into the 4-feet 8½ in. gauge, therefore the alteration from one gauge to the other was to take place in one night, in fact, between the two trains, the last at night and the first in the morning.

The whole distance was 88 miles. The operation occupied about six weeks altogether, but preparations were made beforehand. The alteration was made entirely under his superintendence, and the rails being on transverse sleepers facilitated it materially. No new rails were required, and the boilers being of the same size as those on the 4-feet 8½ in. gauge, the engines could be converted.

Considers it would be advisable to run the same carriages from Euston-square to Edinburgh and Glasgow, were a railway complete. There are men at different stations to see that nothing is wrong, and the carriages, both for passengers and goods, are now so substantial, that they may run many thousand miles without anything but greasing. Goods wagons go at less velocity, and would probably stand it better. The carriage is now much more judiciously constructed than formerly. The strength of carriages conduces very much to safety in case of accident, and the plan of making the under frames of carriages of wrought iron instead of wood, will be carried out to prevent the

harm at present done by splinters. Is projector of the Chester and Holyhead Railway, and will use the 4-feet $8\frac{1}{2}$ inch gauge, that carriages may run from Euston-square to Holyhead; any change would interfere with communication to Ireland. His father and he were consulted as to the lines from Antwerp to Brussels, and from Liege to Ostend, and he was connected with the Leghorn and Pisa, and recommended the 4-feet $8\frac{1}{2}$ inch gauge, as it had been found in this country to answer every purpose. An inch or two, more or less, would have involved a different construction of engines, and he saw no reason for altering that which had been established by experience. Was consulted on the Belgian railways, and on the Leghorn and Pisa. When giving his opinion as to the Belgian lines, the Great Western was not opened, but in reference to the Italian line he had seen both gauges in operation.

Is not aware of any advantage the Great Western possesses, and it has several disadvantages; the additional expense of construction, as in embankments, cuttings, tunnels, bridges, and viaducts, and also in carriages, engines, tenders, workshops, and stations, everything being on an increased scale. The sliding-frame system has to be introduced instead of turn-tables, so that the management of the station is more expensive. Thinks the tear and wear of the carriages on the Great Western is as much as on the narrow lines, and the resistance of the wide carriages is greater; there is more friction of the wheels on the rail to be overcome. The increased expense of the carriage department on the wide gauge would not be in the haulage per mile, but in the fixed establishment of engines. Even the increased boiler, (4 feet 9 inches) of the Great Western would, as nearly as possible, go into the narrow gauge. While he thinks the Great Western has no advantages by the wide gauge, its introduction has involved the country in great inconvenience; if a meeting of gauges takes place in the midst of great traffic, canals would have a decided advantage over railways; the system of boxes and loose-bodied wagons for the transfer of coals has been tried and failed. The loose-box system involves the necessity of increasing the number of carriages on the railway very materially. At Erewash the coal-owners could not avail themselves of the railway, and sent the coals by canal. Coal-owners would prefer transferring their coals from railway to canal, to moving them from one railway to another, on the loose-box system, as by the latter they would lose control over their boxes; they would prefer the transfer by hand, from one railway to another, to loose-boxes. The American railways are universally of the 4 feet $8\frac{1}{2}$ inch gauge. There is a railway from Basle to Strasbourg of 6 feet 3 inch gauge, but parties there deeply regret the alteration, as they look forward to a transfer at each end. There is a line laid down by Deridder, from Ghent to Antwerp, of 3 feet 9 inch gauge; traveled with him on part of that line from Brussels. Has seen, at the Paddington terminus, the modes proposed to supersede the necessity of removing goods and passengers at the junction of different gauges, and believes it would answer the purpose as far as machinery could, but seeing one or two transferred does not convey the amount of inconvenience incident to transferring 100

coal wagons. The other mode of transferring by running the train on another set of trucks, would increase the dead weight to be drawn, so as to be highly objectionable, and the increased height would prevent some classes of goods from getting through the bridges and tunnels. The London and Birmingham goods-wagon, properly laden and placed on the Great Western truck, could not pass under their bridges. The expedient at the Great Western terminus for diminishing and widening their gauge wheels may be safe, but being complicated, he thinks it would not keep in good order; it would also be an expensive arrangement. A modification of the sliding axle was tried on the Newcastle and Carlisle, and soon abandoned. Has not been able to think of any expedient to avoid a transfer; he has seen various ones contrived; the one by Mr. Harding, of the Bristol and Gloucester, is as good a mechanical expedient as any, but that would be so objectionable as to lead to the actual transference of goods in preference. An arrangement at the Birmingham termini for lifting goods-wagons from one level to another is the simplest operation, but if they had to be put on different wagons, the evil would be very much aggravated; even with regard to Birmingham, the inconvenience of the lift is so great, that it is to be abandoned, and an inclined plane substituted.

Is still a locomotive engine-maker, and is of opinion that the 4 feet 8½ inch gauge gives ample space to get the utmost power necessary for working ordinary trains; at present there are, he believes, more powerful engines working on the narrow than on the broad gauge lines. The cylinders of those engines are 16 inches in diameter, the length of stroke is 24 inches, and the wheels vary from 4 feet 6 to 4 feet 9 in diameter. They are all six coupled; and those engines are as heavy as the present rails will bear. They weigh from 22 to 23 tons; I believe the same weight as the Great Western engines. There is now as great a weight upon six wheels upon the narrow gauge as ought to be put upon six wheels; and that will be hereafter the limit of power, not the width of gauge; engines may be built upon the wide gauge, no doubt, heavier and larger in dimensions, and more powerful, but then you must make a road to support it on purpose. The weight of the rails is 75 pounds to the yard; 65 have been used. The width between the bearings varies from 3 ft. to 2 ft. 9. Thinks the narrow-gauge lines best calculated for carrying weight without injury to the road, and the transverse-sleeper system is better for keeping the rails in order than the longitudinal bearings. The expansion and contraction of the iron tend to disturb the action of the sleepers. Instance on the Peterborough line, where the rails had been laid too close, and acted on by the heat of the sun, raised the sleepers three feet into the air. Locomotives can be manufactured for the narrow gauge capable of attaining as high velocities as those on the broad; they are now running upwards of fifty miles an hour, with engines not made for maximum speed. No difficulty in making a narrow-gauge engine to take 40 tons at sixty miles an hour, or more; the engines on the Great Western were made for greater speed, but the average on it was the same, or a little under the Northern and Eastern.—The

average speed of the Great Western is greater than on the London and Birmingham, except for mail trains, which are precisely alike.—Has worked the express trains on the narrow lines with as much economy of coal, &c., as on the Great Western. The express engines on the Birmingham are smaller than others, weighing only 12 or 13 tons, and costing about £1300.—Should recommend those weighing 17 or 18 tons, and costing about £1650. Thinks the public safety would be endangered by having the bodies of the passenger carriages movable at a change of gauge; any slight collision, not otherwise dangerous, would throw them off, besides the risk of porters neglecting the fastenings of each. Would never incur the responsibility of having the bodies separate from the under frames, as, besides other objections, the under frames would be more liable to derangement. The complexity of the broad and narrow gauges in the same station would be great; the turn-table, a most invaluable machine, must be abandoned. Combining two gauges, by laying the rails of one centrally within the other, would get rid of some of the difficulties, but not at stations Turn-tables could be used, but already in the wide gauge system, they are beyond the pale of turn-tables, from the distance between the fore and aft axles of wagons.

In changing from a narrow to a broad gauge line, believes the least evil is to transfer every thing, changing the carriages and moving the goods by hand; with reference to general merchandize, has heard Mr. Brunel express the same opinion. Thinks it would be better to have two rails for the narrow laid within those of the broad gauge, than to have only one, and to use one of the broad gauge rails; as in the latter way, the two trains could not accompany each other, the centre of gravity not being in one line. If the engine were at the head of the trains, it would be of less consequence than if they were propelled from behind. A double system would be required to drive each carriage from the centre, and this is a matter of serious expense. Witness would lay down the narrow within the broad gauge, on the transverse sleepers, and the cost would be about £4000 a mile, or more, in addition; Mr. Brunel estimates a single line additional at £2500, besides the extra cost of station. This is on the supposition that the broad gauge is first laid down on transverse sleepers, but the expense would not be materially different in either case. The rails would not be packed well with longitudinal sleepers, on both systems. In adding a pair of rails within the broad gauge, witness would lay down the transverse sleepers independently; for with other longitudinal sleepers, there would not be room for another bulk like the present, and the ballast of the weight would not be in the centre. Could not mix the systems of sleepers, on account of the length of the transverse, which would almost cut the longitudinal in two. It would be impracticable to lay down the broad on the narrow gauge, without sacrificing one line in tunnels, which would, from danger, amount to a prohibition. On the narrow gauge, 24 feet are required for tunnels, and on the Great Western 4 feet to 6 feet more. Four feet is the minimum space between the two, just room for a man to stand, and the same spaces at each side of the tunnel, and any diminution would

be fatal. Recesses might be made at intervals, to meet a diminution, but a man might not be near a recess when the train came. Recesses could be made after the tunnel is formed, but in many cases the brickwork would thereby be much injured. Impossible to place the broad gauge on the London and Birmingham, without enlarging the tunnels and closing the line for two or three years. Would rather make a new one than enlarge the present Kilsby tunnel. A cutting could not be kept open there, and it would be a gigantic work. With reference to the present and future meeting of the broad and narrow gauge lines, does not apprehend much interruption to the express and other passenger trains at the point of junction, if they are made at the proper places; thinks Bristol and Oxford two places where the two gauges ought to meet, as at these two points he believes there is the least quantity of cross traffic; this explained by witness.

The principal Midland Counties traffic, from Rugby to the Great Western, supposing the double line were constructed from Oxford, would be coals going towards Oxford, and corn coming back. Looking to Southampton as the port, it would only require, supposing the narrow gauge carried down to Oxford, a line from Oxford to the South Western to complete the narrow gauge system, over the kingdom, as far as Southampton is concerned; the Great Western Company have a line from Reading to Basingstoke, and if that were laid on the narrow gauge, and the double system from Reading to Oxford, there would be no break in the country at all; commercially, Southampton, London, Bristol, and Liverpool, would interchange with each other, and with the manufacturing districts, by the same carriages. No extension of the wide gauge towards the London and Birmingham would relieve Lancashire or Yorkshire from a change of gauge, but an extension of the narrow from Oxford to Basingstoke would relieve the whole question of embarrassment. The Great Western Company can be compelled to lay down the double gauge from Rugby to Oxford, and on the greater portion from Wolverhampton to Oxford, and to Worcester, as they agreed to do that. The loss of time in transferring a passenger train at Rugby to go to Oxford on the broad gauge, would depend on the amount of passenger traffic; it is a point of small passenger traffic; it may be a large one of coals and corn; the extension of the wide gauge into that district must multiply the points of junction of the two gauges, and the chances of interruption: passenger trains could not be changed in less than half an hour. Has experienced the inconvenience of changing carriages, and scrambling for luggage on the Belgian railways, at Malines. Was detained the last time about half an hour. If the change of gauge took place at Rugby, a new station would be required.

With regard to agricultural traffic, at any point of change, the beasts would require to be grazed before removing them from one carriage to another, and is afraid the loose bodies would be required for pigs; they could not be managed otherwise; they must be lifted *en masse.* The wagons themselves upon the narrow gauge vary from 2 tons 10 cwt. to 3 tons; some recent large ones run as far as 3 tons 10 cwt., and they will carry 5 and 6 tons of goods. I think the latter is as

near two to one as possible; that is, that if the dead weight is one, the useful weight is two. The difference is here against the broad gauge: the trucks for intermediate traffic seldom average more than a ton each, so that all the intermediate traffic on the Great Western is carried on with trucks of five tons, with one ton of goods in them. As railways extend into every corner of the country, the advantages of the narrow gauge would be most apparent, and as the wide is more expensive than the narrow, the former would limit the ramifications of railways. The narrow gauge wagons are infinitely superior for mineral traffic, particularly coal; if the mixed gauge system be allowed to extend in this country, the charge on coal will amount in many cases to a prohibition. Thinks the broad gauge has a disadvantage as to horse-boxes; their motion is sometimes fearful; they want length with reference to their width, while on the narrow gauge a carriage of the same length might be very steady. Prefers the narrow gauge passenger carriages, carrying three in width, to those of the wide, carrying four; the latter are cold in winter, and want ventilation in summer. There has not been so much attention paid to the construction of the narrow gauge passenger carriages as to the broad, but the narrow could be made 6 feet high, so that a person might stand up in them. The lowest longitudinal distance between the axles of 4 and 6 wheeled engines on the narrow gauge, is 10 feet, and the highest 12 feet 9 inches; the last are too long; witness adopts a maximum of 12, and a minimum of 10 feet; relatively the centre of gravity is the same height in both gauges. Though there would be great difference as to the cost of constructing the broad and narrow lines, cannot say there is any difference in the cost of working. Whether the traffic be much or little, it is merely a question of expenditure of power, and though the most powerful engine is cheapest to work with a proportionate load, each may have engines of the same power.

The wide gauge engines are not more powerful, but are heavier in proportion to their power; everything in the width gives the engine no power at all, but is an encumbrance. Neither commercially nor mechanically has the wide gauge any advantage over the narrow, but rather the contrary. The driving wheels of the broad gauge engines are not generally of greater diameter than the narrow; 6 and 7 feet engine wheels are used on the Great Western. The greater diameter of the driving wheels has a tendency to reduce the axle friction; but comparing 6 and 7 feet, the amount of this is not worth measuring, but if by increasing the gauge, the axle has to be increased in size for strength, what is gained on the one hand is lost on the other. The friction of the flange of the wheels against the railway has a retarding effect on curves, but not much on straight lines. Any lateral friction arises from the angle of the wheel against the line, and must be greater on the wide than the narrow gauge; around curves the sliding motion must be directly as the width of the gauge.

The evaporating power of a passenger engine on the Northern and Eastern, is about 130 cubic feet an hour; he has some evaporating 160 feet. The most powerful engines are constructed with either outside or inside cylinders; the largest are inside. Certainly, some en-

gines that have been recently made with outside cylinders have much more of that motion than I like. It is exceedingly difficult to say how the motion is produced; if you consider the action of the cylinder, it is perfectly rigid metal—engine and cylinder altogether. Now, when the steam presses upon the piston, it is at the same time pressing against the lid of the cylinder; the action and reaction must be equal. Therefore, that it is not the steam that causes the irregular action, but the mere weight of the pistons themselves, and therefore if we could contrive to balance the pistons by the weight upon the wheel, we should get rid of that very much; but in the most recent designs of engines of that kind, he has brought the cylinder much nearer to the driving wheel, and nearer to the centre of the engine; at present they hang over the wheels a good deal; now he has brought them within the wheels.

It is now an indispensable part of the broad-gauge system to use the longitudinal bearings; it is a question of expense. As you increase the width of the gauge, of course, on the longitudinal system, it leaves the expense the same; whereas, if you adhere to the transverse system, you increase the size, and of course, you increase the expense more rapidly; therefore the transverse system with a very wide gauge would be very objectionable on account of its expense, but I think the principle of construction would be better. With reference to the maintenance of the way, imagines that the way is kept in better order upon the tranverse system than upon the longitudinal at the same expense; has never seen any portion of longitudinal bearing railway in perfect order. It is more difficult to pack, and there is always more friction in a longitudinal railway than in a sleeper railway. The Hull and Selby is part of it longitudinal and part of it transverse. The engines where they were heavily laden, upon the longitudinal bearings would just creep along; the moment they got to the tranverse bearings they went 5 or 6 miles an hour more directly, from the yielding in one system, which gives a little less noise and a little softer motion which the Great Western has. Does not think in that particular case it resulted from the longitudinal bearings being of insufficient dimensions and slighter than the Great Western, thinks they were the same size;—Memel balks, 12 or 14 inches square, cut up; and the Great Western are 14 inch balks. In the longitudinal system there is a little less noise, and there is a little softer motion than upon the transverse system, but there is a great deal more motion; there is far more actual motion upon every longitudinal railway than upon the transverse sleeper system.

If the London and Birmingham had originally been made on the broad gauge, estimates that it would have cost about 3000*l.* a mile more, without including the additional cost of the central station at Wolverton, which must have been much larger. As to altering the existing gauge on the London and Birmingham, thinks it would stop the line for at least two years, that it is practically impossible. It would cost about 15*l.* a yard for tunnelling, taking good ground and bad. To make the Kilsby tunnel as large as the Great Western tunnels, it would have cost a great deal more than that. On the other

hand, in increasing the size of the tunnel in good ground, such as chalk, the additional cost would not have been so much. States the results of experiments, showing the consumption of fuel and water, by an engine with different load. Found that the consumption of fuel for drawing the engine without a load, was equal to about the consumption of fuel to overcome a load of 15 carriages at 30 miles an hour; that is, it took as much to move the engine and tender as it did additional to move 15 carriages. There have been many reasonings upon that without considering the precise application of it. A large proportion of the fuel in moving the engine alone is consumed in overcoming the resistance of the atmosphere to the pistons; it will not require more than three or four pounds to overcome the friction of the engine and tender proper, but it requires 15 pounds in addition to that to overcome the engine and tender, taking into account the atmospheric resistance to the piston; so that there is always 15 pounds of pressure of steam in all high-pressure engines absolutely lost; it is not the friction of the engine; certainly it is a defect in the engine from its being a high-pressure engine, but on no other account. It is not a peculiar loss applicable to locomotive engines alone, but to all high-pressure engines; and therefore in estimating the consumption of fuel and dividing the proportion of expenses, it became important to ascertain what was the relative expense of conveying 8 carriages, and of conveying 15, because all the trains of the Croydon Company were small, and all the trains of the Dover Company were comparatively large; and from this experiment it appears that as to the cost of coke, whether to convey 8 carriages or 15, there is a very small difference. Therefore, if you proportion your expenses by the load, you give the small load very greatly the advantage, because you charge them only half the fuel, say as 8 is to 15, whereas you ought to charge them as 8 plus the engine is to 15 plus the engine, which will make a very great difference.

Believes the gauge of the Dutch railways, constructed in 1842, to be 6 feet 5½. The Amsterdam and Haarlem Railway is essentially level, and laid on longitudinal timbers, which are best suited to the unsound ground of Holland. The line laid over Chatmoss is laid on transverse sleepers, but the moss there has much more tenacity than the substratum of peat in the low part of Holland. Mr. Conrad constructed or projected the line in Holland; he examined railways in this country, but does not know whether he was assisted by any English engineers.

(To be continued.)

Blasting Shoals in the River Severn.

At the Institution of Civil Engineers, on Wednesday night, the paper read was by Mr. G. Edwards, member of the Institution of Civil Engineers. It described the method employed for breaking up the shoals in the river Severn, between Stourport and Gloucester. These shoals consist of marl rock, so compact and tough as to resist all attempts to break it up with the stream dredger, or by prize bars,

or with a powerful species of subsoil plough. Recourse was therefore had to blasting with gunpowder, and the process of these operations formed the subject of the paper. Messrs. Grissell & Peto were the contractors for the work, and for them Mr. Edwards designed and executed the blasting operations. A series of rafts were moored in a line over the shoal, parallel with the bank of the river. Along the centre of each raft there was an opening, through which wrought iron tubes, 3½ inches diameter, were driven down, at intervals of six feet apart, through the gravel down to the marl; withinside these tubes the workmen used the chisel-pointed jumper to make the shot holes, to a depth of six feet below the surface. The loose stuff was extracted by an auger. A tool cartridge of canvas well pitched and tallowed, containing three pounds of powder, was lowered through the tube into the hole, which was well rammed with loose marl. The charge was then fired by means of Bickford's fuse. There was generally but little apparent external effect from the shot, except lifting the pipe a few inches. But sometimes a column of water would be driven up through the water to a height of forty or fifty feet. It was found that each shot had loosened a mass of marl of conical or parabolic form, of which the bore hole was the centre, and its bottom the apex, so that four adjoining shots of two parallel lines would leave between them a pyramidal piece of marl, which was removed by the dredging machine with the loose stuff. This operation of blasting was repeated in parallel lines along all the shoals, and the stuff was dredged up at the rate of 200 to 300 tons per day. The cost of blasting was about 1s. 9d. per cubic yard. It was stated that the six principal shoals had all been successfully operated upon, and great credit was given not only to the design, but also to Mr. Edwards for the systematic and complete manner in which he had arranged and conducted the operations.

The Society showed their approbation of Mr. Edwards' abilities by awarding him the Telford medal for 1845. We may add that many thousand tons of matter have been thus already broken up and raised; that two dredging machines are now regularly employed, and that the works are progressing in the most satisfactory manner. As the tolls empowered by the Act cannot be imposed until there is six feet water from Stourport to Gloucester, every possible exertion is being used by the contractors, Messrs. Grissell & Peto to expedite the completion of the work; two dredging machines have lately been working from 3 a. m to 9 p. m., indeed, we are informed, one of them No. 1, absolutely raised the surprising quantity of 900 tons! one day last week. A third dredging machine, built by Mr. Rebel, of Gloucester, under the direction of Mr. Edwards, was launched last week, and will very shortly be ready for work. Viewing the magnitude and difficulties of the works we consider it fortunate for the Commissioners that they have been entrusted to such responsible parties as Messrs. Grissell & Peto, who have at their command the means and the talent necessary for anything that may be required to be executed. We are told it is no uncommon circumstance for this firm to have in their employment at one time, on different works, as many as 10,000 men.

Naut. Mag.

On the Profitable Increase in Traffic on Railways as produced by Great Reduction in the Charges. By Mr. B. Williams.

The carriage of goods, the original object in the construction of railways, has been kept out of view until lately by the increase in passenger traffic calling for all the energies of the managers, and the entire revenues of the companies, except on the old established lines, where it has been proved, Mr. Williams states, that the increase of nett profits from goods is greater than the increase of nett profits from passengers. Goods of small bulk, compared with their value, may be sent by railway, but not agricultural or mineral produce, generally goods of great weight and bulk in proportion to their value at the present high charges, although a railway is the construction of all others calculated to meet this demand by its mechanical power. It is a great and costly machine or engine, the produce of which is cheap if it be fully employed,—if the machine be idle or work with incomplete action, a loss of interest on the great outlay must be the result. The cost of conveyance on all railways, in Mr. Williams's opinion, admits of being separated into two elements; first, interest on capital, together with certain fixed charges, which are independent of the greater or less use made of the railway; second, the actual working expenses that result directly from the work done. In Belgium, in order to provide interest at the rate of 5 per cent. on the original cost of the railways, with a goods traffic per mile per annum of 40,000 tons (the actual traffic to the year 1844 on the Belgium Railways) the charges would consist of 3d. for interest and other fixed demands, and ½d. for working expenses, making a total charge of 3½d. required, with that amount of tonnage, to pay 5 per cent. on the capital. The actual charge was 2½d. per ton per mile, and the railways were then working at a loss, the Government having borrowed the capital for their construction at 5 per cent., and having in nett return, after defraying the expenses, only 2½ per cent. Yet at the very time the railways, with their superior advantages in economy of time and regularity of delivery, were carrying only 40,000 tons per mile per annum, the canals were carrying 400,000 tons. The charge on the latter was 1¼d. per ton per mile, or half of the charge on the railways. Had the railways but carried one-half of the tonnage of the Canal Company at the canal charges, instead of an annual loss to the revenue of 60,100*l*, there would have been an annual gain of 52,500*l*. Mr. Williams illustrated his paper with various tables and returns, calculated upon data embracing the average cost of railways in England, and funding for interest at the rate of 5 and of 10 per cent. on the capital. The tables showed of how much importance it is for the benefit of the public, consistently with the pecuniary interest of the capitalists, that large quantities of goods should be carried;—that, for example, while, with an average traffic of 100,000 tons per mile per annum, the charge required to produce 10 per cent. on the capital, after paying the working expenses, should be about 4½d., with an annual traffic per mile of 500,000 tons, a charge of 1¼d. per ton on the average of all goods would produce an equal return after paying

the expenses. This subject was pursued, illustrated by tables, with reference to the conveyance of passengers, of various classes of goods, cattle, &c. The applicability of these tables to test the substantial character of new schemes was made apparent. A necessary conclusion of Mr. Williams's investigation is, that expansibility in the railway system (both as regards the mechanical power and the mode of management) is required ; and that it is the interest of the companies to increase, in a great degree, both the goods and the passenger traffic by a system of low charges. It is to the interest of the public that as much traffic as possible should belong to each line, and thus competing lines are highly injurious to the public, by preventing the reduction in charges that can only be the result of the conveyance of numbers of persons and quantities of goods ; in other words, the machine should be kept fully employed.—*Trans. Statistical Soc.* Athenæum.

Improvement of the Clyde Navigation.

The discussion upon the improvement of the Clyde Navigation was renewed by a statement from Mr. Atherton, formerly resident engineer of the Clyde under Mr. Telford. He gave a brief exposition of the past history of the Clyde navigation, from the time when the only craft on the river was a few herring boats, and the water was suffered to overflow a wide extent on either side of the channel, converting it into an extensive morass. He then gave the various projects for improving the navigation—Smeaton's design for a lock on the main channel, which fortunately was never executed. To Rennie, it appeared to be universally admitted, must be attributed the credit of propounding the general principle of the Clyde improvements, which were commenced under him, and were so successfully continued by Telford and others. Rennie's principle was, that the whole surface waters of the river should be brought within definite limits; that in the lower parts those limits should be very spacious, but gradually and equally diminishing upward, not by sudden *intakes*, but by gradual convergence of the restricted width. By this principle, the current of the land flood being concentrated, their power of augmenting the depth of the channel would have full opportunity of acting beneficially. It was also expected, that the rising tidal waters, entering between the widely extended limits of the lower districts, would expend their momentum as they ascended the conveying channel, in raising the height of the tidal wave, and produce an effect analogous to the extraordinary elevation attained by the tides in the Severn, in consequence of the gradual convergence of the shores of the Bristol Channel. Thus, the land floods and the sea tides were to combine in producing useful effects—the velocity of the former in deepening the channel at low water ; the latter in preserving or continuing the surface of high water, even to Glasgow, at the estuary level. The difficulty was in commencing the works without funds ; they were, however, begun in an economical manner, by running out jetties of fascines of wood and stone, from the opposite sides of the river, so as

to bring the channel within certain limits. The effect of these jetties was to commence the deepening of the channel, by increasing the scour. Owing to the increase of manufactories, and of the iron and coal trade at Glasgow, shipping began to frequent the river; the port dues were kept low; and an annual revenue commenced; greater exertions were made to increase the facilities for admitting ships of greater draught. Telford followed in Rennie's footsteps, by uniting by stone dykes longitudinally the extremities of the projecting jetties: steam dredging boats were employed to cut away the shoals, and diving-bells to remove the rocks which impeded the free current of the stream. Walker followed the same course, and the result was, that the depth of water was so increased, that instead of only being capable of receiving fishing-boats of a draught of water of under 6 ft., vessels drawing 17 ft. were tugged by steamers to Glasgow quays, and the annual revenue of the port at present exceeded 50,000*l.* The speaker proceeded to comment with eulogy upon the proceedings of the Clyde trustees and their engineers—and dissented from the views of the Tidal Harbor Commission, in their recommendation of opening up the river for the free admission of the tidal water, so as to cause them to act by reflux; which it was contended by the speaker generally would not be so effective, as continuing to improve the channel, and persevering in the same course which had hitherto proved so effectual. Some discussion ensued, as to the propriety of some measures being adopted in certain parts of the river: but it appeared generally admitted that the work, so wisely conceived, had been very ably conducted, and that the results were to render the Clyde a model for works under similar circumstances.—*Trans. Ins. Civ. Eng.*

Min. Jour.

On the Lines of Propulsion in the Steamboat, Locomotive, &c. By T. W. Bakewell, Esq.

The writer is not aware of any scientific examination to determine the points through which the lines of propulsion pass—as respects a steamboat, a railroad locomotive, or a boat when rowed.

The erroneous opinion prevails, that the lines of propulsion in the above cases, are in the axles of the wheels, with the steamboat and locomotive,—and in the gunwale of the boat on which the oar rests.

The line of propulsion of the steamboat is in the paddle, at the centre of percussion, beneath the surface of the water. The locomotive has the lines at the circumference of the driving wheel, where it touches the rail, and its direction is parallel thereto. And the row boat has the line at the end of the oars in the water.

In the locomotive, for instance, this principle may be plainly perceived by supposing a rope made fast ahead, stretched along the rail, and passing under the wheel,—so that the locomotive should advance by winding the rope round the wheel, instead of by adhesion on the rail.

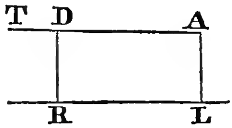
Now it is evident that the line of propulsion remains unchanged—

whether the locomotive advance itself, by drawing on the rope, or the wheel be made stationary by the steam on the engine opposing an active force at the end of the rope, which should advance the locomotive.

As to the row boat, it is true,—if we row on the larboard oar, the boat will turn to the right, but not because the line of propulsion is in the larboard gunwale—for if we raise a place for the oar, on the starboard gunwale, so that the oar can pass freely over the boat and larboard gunwale into the water—and erect a stage outside the boat, on the starboard side, to enable us to work the oar—the boat will still turn to the right, although in this arrangement the oar rests on the starboard gunwale.

The practical benefit resulting from a consideration of the above facts may not be important; with the locomotive, however, they may be worthy of note, as they show that the pressure of the driving wheel on the rail, for friction, is influenced by other causes than the weight borne by itself.

Let R to L, be the propelling force on the rail, and A to D, the equal resisting force of the train T. Let D R, be the position and direction of the weight on the driving wheel, and A L, of the weight on the driven wheel, or system of wheels, if more than one.



These forces will always exist, and act in the locomotive, although the lines representing them may not coincide with, or be traced through any material in its construction—and there are several views by which we may arrive at their effects. Let it suffice that we have the crooked lever R D A, whereof R, the bottom of the driving wheel on the rail, is the fulcrum.

Then by the opposing forces R L, and A D, the proportion of weight transfered from A L, to become pressure on D R, will be inversely as A D, to D R.

Now we can suppose forces R L, and A D, to be of sufficient intensity to raise A L, from the rail, when the whole weight would be converted into pressure on the driving wheel. In case the locomotive should push the train, or draw it, having the driving wheel in advance,—the pressure on it would be lessened according to the above law, in its reversed action, and the fulcrum would be at L.

AMERICAN PATENTS.

List of American Patents which issued in the month of September, 1845. *With Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

Continued from Page 216.

29. For an improvement in *Stoves;* Peter J. Chute, Schenectady, New York, September 19.

Claim.—" What I claim as my invention, and desire to secure by

letters patent, is the arrangement of the dumb flues surrounding and within the oven, in the manner and for the purpose set forth."

These dumb flues communicate with the horizontal flues at bottom, and are closed at top, so that there is no circulation through them; they are necessarily heated by radiation from the main flues.

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30. For improvements in the *Hot-air Furnace for Heating Buildings;* H. L. B. Lewis, New York City, New York, September 19.

Claim.—"What I claim and desire to secure by letters patent, is 1st, the *gate* and *agitator;* the bars of the latter working with freedom between the bars of the former, in such a manner as to free the coal of ashes, so as to insure active combination.

"2d. Also, the arrangement of the collars, containing a number of holes in combination with the combustion cylinder and zigzag smoke pipes, for the purpose of preventing the too rapid escape of air into the apartment next above, before it is sufficiently heated.

"3d. Likewise the arrangement of plate B, in combination with the combustion cylinder and smoke pipes, as described.

"4th. And also the arrangement of plate C, containing the register for regulating the draught through the coal, in combination with the register, and smoke pipes, and combustion cylinder."

The improvement covered by the first claim needs not to be described. That covered by the second claim consists of two perforated horizontal plates to intercept the current of air as it passes up through the chamber surrounding the fire-box, when this is combined with the pipes in the apartment above, which are elbowed to increase the heating surface, and which also impede the escape of the air. The third claim is for combining with the elbow pipes a circular plate with holes, by which the passage from these pipes can be regulated at pleasure. And the fourth is for combining with the above arrangements a register plate, for regulating the admission of air to the grate.

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31. For an improved method of *Combining and Connecting Cranks and Crank Pins of Steam Engines;* Frederick E. Sickels, New York City, New York, September 19.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is connecting a crank pin with two cranks, by means of turning and sliding joints combined, whether the pin be made to slide in both cranks or only in one, so as to equalize the strain of the engine on each crank, and allow them to move and compensate for any error in the relative position of the crank shafts, as herein described."

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32. For an improvement in the method of *Hanging Doors;* Aaron B. Carpenter, New York City, New York, September 19.

Claim.—"I do not claim to have invented any of the parts herein described and shown except as follows:

"I claim as new and of my own invention, and desire to secure by letters patent, the application of the movable hanging stile, hinged in

a rebate in the doors or sash stile, and steadied in a groove in the jam by screws, either without or in combination with the springs H and K, and roller I, and inclusive of any variations arising from the nature of the particular case, when such application and combination or variations, for the purposes herein described, are substantially the same in construction and practical effect, and shall be used in hanging or mounting French sashes, casement windows, or folding doors, of any description and for any purpose."

The casement, sash, or folding doors, instead of being jointed to the permanent frame, are hung to a "stile," which slides in a rebate, and provided with springs that force together the two halves of the door, or sash, when closed, to insure a close joint.

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33. For an improved method of *operating the Drop cut-off Valves of Steam Engines;* Frederick E. Sickels, New York City, New York, September 19.

The patentee says:—"By the method now practised of operating the drop cut-off valve, the motion is derived from the lifter, which approaches its state of rest as the piston of the engine approaches the middle of its stroke, or its maximum velocity, and the valve is tripped by the same motion which lifts it, so that there must be very great nicety in the adjustment to regulate the extent of the cut-off at about the half stroke. The object of my invention is to remedy this, and its principle or character consists in tripping the valve by a motion independent of the motion of the lifting-rod or rods. And, also, in combining the various parts in such manner as to regulate the cut-off with accuracy during the action of the engine, by connecting the two shafts that trip the two cut-off valves end to end, by means of adjustable spring arms that take into, and are, when set, held in the teeth of a sector, which vibrates on the axis of motion of the shafts, and receives its vibratory motion from the eccentric,—which spring arms may be shifted in the teeth of the sector, brought nearer to, or farther from each other, and thus cut off at a less or greater portion of the stroke."

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34. For a method of *Casting the Steam Chests with the Cylinder, and with the Cylinder Bottom and Condenser;* Frederick E. Sickels, New York City, New York, September 19.

The patentee says:—"In forming the connexion of a steam cylinder with the steam chests of puppet valve engines, it has long been known to engineers, that the closeness of this connexion is important in an economical point of view, not only on account of the weight and cost of materials employed in making a long connexion, but because all the steam contained in this connexion is condensed or otherwise lost at each stroke of the engine; and hence various devices have been resorted to by engineers to surmount this difficulty—the steam chest has been variously arranged and located; but still all these devices have presented a large area between the chest and the cylinder, for the steam chest being cast separate from the cylinder, sufficient

room must be left to form the connexion by bolted flanches, which necessarily occupy much room. To remedy these evils is the object of my invention, the nature of which consists in casting the steam chests in one piece with the steam cylinder, or one with the cylinder and the other with the condenser and the cylinder bottom, by making the side of the cylinder the side of the steam chest, and so of the condenser; and also in so forming and adapting the appendages of these parts as to enable them to come together, and to unite the cylinder head with the cylinder, and the cylinder bottom within the narrow compass left between the steam chest and cylinder where they are brought in such close proximity. The flanch on the cylinder and cylinder bottom being dispensed with towards the steam chest, and instead thereof a joint made between the chest and cylinder by packing or driving, and screws inserted from the inside of the steam chest and screwing into the solid metal of the cylinder, for the lower steam chest, and for the upper end, recesses being made in the side of the steam chest to admit the requisite screw bolts for screwing the cylinder head.

"I do not claim letters patent simply for casting the steam chests with the cylinder, or with the cylinder bottom and condenser; but what I do claim as my invention, and desire to secure by letters patent, is casting the steam chests with the cylinder, or one with the cylinder and the other with the cylinder bottom and condenser, by making the side of the steam chest the side of the cylinder or condenser, in combination with the manner of fitting the cylinder head and the lower end of the cylinder to the chests, and the mode of making the attachments without the continuation of the flanches, thus dispensing with the nozles and nozle flanches, and their attachments, and saving at each stroke the steam contained in the nozles, all as herein described."

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35. For an improvement in the *Portable Bath;* Nelson Bartlett, Belvidere, Illinois, September 23.

Claim.—"Having thus fully described my improvements, what I claim as my invention, and desire to secure by letters patent, is constructing the receiver, in the manner and for the purpose described, viz: by supporting its edges with springs, as set forth."

The receiver is made of india rubber cloth with the edges turned and sustained by means of spiral springs.

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36. For a machine for *Grinding Spiral Knives;* William Hovey, Worcester, Massachusetts, September 23.

The patentee says:—"The nature of my invention consists in attaching the twisted (sometimes called spiral) blades or cutters to a flanch projecting from a stock hung on journals in a traversing carriage, so as to present the back of the cutter to be ground to the action of a grindstone, or other reducing or polishing wheel, so that as the

cutter on the carriage traverses lengthwise, it shall vibrate freely on the axis of the stock to which it is attached, to follow the twist of the blade, and grind it to a sharp edge such as is required in cutting, by impinging the cutting edges against the surface of a cylinder by the rotation of the two cylinders or the cutting cylinder on a plane, the cutting being effected by a pressure towards the centre of the axis of the cylinder of knives. The reciprocating motion of the cutters during the traverse motion, being governed by the spiral or twisted surface of the knife itself or any thing analogous thereto.

"What I claim as my invention, and desire to secure by letters patent, is giving to the spiral, or twisted, knife or cutter, attached to a flanch in a line radiating (or nearly so) from the axis of the stock, a traversing motion in the direction of its axis, in combination with a reciprocating rotary motion on its axis, when this latter motion is governed by the twisted plane of the cutter, or any thing essentially the same, to enable the grinder to give the required level to the ground face, and the proper line to the edge, substantially in the manner herein described."

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37. For improvements in the *Spark Arrester;* William C. Grimes, Philadelphia, Pennsylvania, September 23.

Claim.—"What I claim as new, and as constituting my invention, and desire to secure by letters patent, is the forming or dividing of the upper part of the chimney into two or more curved and divergent branches or flues, with the inner walls of each formed in part or wholly of perforated sheet iron, upon the principle and for the purpose hereinbefore set forth.

"I also claim the combination of the tubes or radial branches with the exterior case or jacket, forming as it does a chamber around and below them."

The object of making the two curved branches with the inner walls perforated, and the outer walls imperforated, is that the centrifugal action shall force the sparks against the outside, whilst the gases can escape through the perforations of the inner walls.

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38. For improvements in the machine for *Cutting Laths;* Samuel Cheney, Cleveland, Ohio, September 27.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is first, the combination of the griping bars, bent levers, and inclined planes, for griping the block for cutting the lath, as herein set forth.

"Second, the combination of the 'self-clearers' with the rest and knife, as herein described.

"Third, the counting apparatus, constructed substantially as herein described, in combination with the lath-cutting machine."

The block is griped previous to each cut by means of a griping bar which is forced down by wedges or inclined planes on the slide of the cutter, acting on bent levers, jointed to the griping bar. So soon as

the lath is cut, it is liberated and forced out into recesses formed by arms on a shaft which is slowly turned by a ratchet, operated by the slide of the cutter so as to discharge the laths after a given quantity has been cut.

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39. For an improved method of *Heating Dining Tables;* H. L. B. Lewis, New York City, New York, September 27.

Claim.—"What I claim as my invention. and desire to secure by letters patent, is the particular manner of constructing the dining table to be heated with pure hot air, introduced by means of pipes from a furnace as above described."

The hot air from a furnace passes through a chamber extending the whole length of the table and formed by the top which is of wood perforated with numerous holes and covered with sheet metal, and wooden bottom and sides. The circulation of heated air will heat the dishes, plates, &c.

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40. For an improvement in the method of *making Continuous Percussion Primers for Fire Arms, and in the Lock therefor;* Edward Maynard, Washington, District of Columbia, September 27.

Claim.—"And, having thus fully explained the character of my invention, the essential modes of application, and the manner of making and using the same, what I claim as my invention, and as distinguished from all other things before known, is—first, making primers of fulminating mixtures, or such compounds as ignite by percussion, in a continuous series, each primer, or any two or greater number, being separated from the others by a substance which is less combustible than the fulminating mixture, by which one or more may be exploded without communicating fire to the others.

"Secondly, the mode described of moving and measuring out the primers, by the movement of the lock, substantially as described."

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41. For an improvement in the *Straw Cutter;* Grey Utley, Chapel Hill, North Carolina, September 27.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the before described construction of the knife; that is to say, making it with a series of sharp cutting edges, commencing near the top of the blade, on each side, and gradually downward and inward towards the centre, forming a serrated concave edge on both sides, each cutting edge being made in horizontal and parallel lines, the lower point being made sharp, so as to pierce the article to be cut first, and each succeeding knife following in its turn and cutting the article."

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42. For an improvement in the *Æolian Attachment for Pianos;* Charles Horst, New Orleans, Louisiana, September 27.

This is for so arranging the reeds as to admit of tuning them by simply turning a screw.

Claim.—" What I claim as my invention and desire to secure by letters patent, is the confining the thin metallic reed used in the above named instruments, to a sliding plate, and securing the said metallic reed and sliding plate in a case, so that the pitch of the reed may be raised or lowered by the turning of a screw attached to the sliding plate, substantially in the manner and for the purpose herein described and set forth."

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43. For an improvement in the *Saw Mill for Sawing Lumber in Curves;* Frederick W. Harris, Lancaster, Massachusetts, September 27.

Claim.—" Having thus described my invention, I shall claim the above mode of guiding the saws, the same being effected by the curved slots of the pattern plates and blocks through which the saw works, in combination with vibrating arms applied to the saw frame and saw, as set forth, the whole being substantially as hereinbefore explained."

The saw is connected with arms, to admit of its turning to follow the curves of the grooves in the patterns, in which it moves up and down.

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44. For an improved mode of *Tuning the Reeds used in the Æolian Attachment to Pianos;* Martin and Nicholas Schneider, New Orleans, Louisiana, September 27.

Claim.—" What we claim as our invention, and desire to secure by letters patent, is the method above described, of tuning the tongues or reeds of accordeons or seraphinas, and other instruments deriving their tones from the vibration of metallic reeds, by means of movable clamps, which gripe the reeds, and embrace a part of the plate to which the reeds are attached, and admit of sliding or moving to increase or decrease the length of the vibrating part of the reed, and thus regulate the tone, as herein described."

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45. For an improved *Platform for taking off, and putting on, the wheels of Locomotive Steam Engines;* Thomas D. Simpson, Norwich, Connecticut, September 27.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the method of removing and putting in the driving and truck-wheels of locomotive and other railroad carriages, by the employment of a vertically moving platform for letting down and raising up the wheels, in combination with the permanent railway and trussel, or other support for the locomotive or car frame, substantially as herein described."

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46. For an improvement in *Stoves;* James Pedder, Philadelphia, Pennsylvania, September 27.

Claim.—" I do not claim simply the employment of a reverberator

in a stove or fire-place, as this has heretofore been done, but for a different purpose and in a different manner; and therefore, what I claim as my improvement and desire to secure by letters patent, is the combination of a flanch or 'reverberator' with the hood or muzzle of a stove, under the eduction pipe or aperture, and projecting in front thereof, and inclining downwards, whether of a greater or less width, or set at a greater or less angle, substantially in the manner and for the purpose set forth."

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47. For an improvement in the method of *Driving Spindles, Flyers, or Bobbins, of Spinning Machines;* William Baxter, Paterson, New Jersey, September 27.

The patentee says:—"No part of the operation of spinning has been attended with so much difficulty as that of driving the flyer or bobbin, on account of the great velocities required and the delicate texture of the fibres under operation, for high velocities tend to produce variations in the rotating body, particularly if not made perfectly true, which break the threads and thus retard the operation, and render the spinning of fine threads impracticable. Cog wheels have long since been considered inapplicable to the driving of spindles or bobbins under high velocities, and belts applied as heretofore, tend, by the necessary strain required to prevent slipping, to increase, nay, to produce unsteadiness of motion and much friction, and consequent wear of the parts, soon resulting in unsteadiness of motion and in a waste of power. Efforts have been made to overcome these great practical difficulties by resting the edge of the bobbin or warve of the spindle on the periphery of a wheel, or on a round belt; but when thus driven, great velocities tend to lift or throw up the bobbin or spindle, there being no provision for preventing so injurious an effect. The object of my invention is to remove all these difficulties, by means of an arrangement which consists in driving bobbins or spindles by a belt, which is embraced by two flanches on the warve, the belt being so arranged as not to press against the periphery of the warve, but merely to hold the bobbin or spindle in suspense by the two flanches, the space between which is equal to the width of the belt, to prevent any vertical movement."

Claim.—"I do not claim as my invention making the warves of spindles, flyers, or tubes for carrying bobbins or spools, with flanches, nor the driving of them by a belt; nor do I claim driving spindles, flyers, bobbins, or spools, &c., by resting them on a belt, as all these devices and methods have been known and used before, but not as I have applied them; and, therefore, what I claim as my invention and desire to secure by letters patent, is driving spindles, flyers, bobbins, or spools, &c., by means of a belt with parallel edges equal (or nearly so) in width to the space between the flanches of the warves, and passing between them, when these warves are so arranged as to be suspended thereon, without the belt bearing against their peripheries, for the purpose and in the manner substantially as herein described."

48. For an improvement in the *Machine for Cutting Grain;* Ferdinand Woodward, Upper Freehold, New Jersey, September 27.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of a sheaf box with the platform into which the grain is thrown before being deposited upon the ground from the platform."

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49. For improvements in the *Spark Arrester;* William Duff, Baltimore, Maryland, September 27.

"The nature of my invention consists in making the side of the perforated tubes, which surround the central tube of the chimney, and through which the smoke and other products of combustion have to pass, of imperforated sheet metal to avoid the direct action of the exhaust from carrying sparks through the perforations in the tubes, and also in making a communication between the spark arrester around the chimney and a space at the lower part of the small box made by a partition therein, which space communicates with the fire chamber by means of tubes corresponding with the flues, but below them, so that the action of the exhaust, in producing a draught through the flues, partly exhausts the tubes below the flues, and thereby tends to draw all the sparks back into the fire to be consumed, whilst at the same time, this back current tends to keep the perforated surfaces clear for the passage of the smoke, &c."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrrangement of the series of tubes around the chimney, with their imperforated surfaces towards the centre of the chimney, to prevent the direct action of the exhaust, &c., from forcing the sparks through the perforations, as herein described.

"I also claim the arrangement of the damper, or valve, with the inverted concave plate and cone at bottom, in combination with the series of tubes composed of perforated and imperforated surfaces.

"I also claim, in combination with the series of tubes surrounding the chimney, the tubes attached to the outer casing, or the equivalents thereof, for conducting the sparks into the receptacle, that are carried by the force of the current up to the top, as herein described.

"And, finally, I claim connecting the fire chamber with the receptacle for the sparks, made in the lower part of the smoke box, by a partition therein, by means of a lower tube or range of tubes corresponding with the flue-tubes, so as to carry back the sparks to the fire chamber by an arrangement entirely within the casing of the boiler and furnace, and acted upon by the current, as herein described."

List of American Patents which issued in the month of March, 1842,—*with Exemplifications, by* Charles M. Keller, *late Chief Examiner in the United States Patent Office.*

Continued from page 118.

15. For improvements in the *Springs of Railroad Cars;* Joseph F. Talson, Jersey City, N. J., March 18.

Three or more helical springs are arranged one within another, and placed within a cylinder, so as to be compressed between one of the heads of the cylinder and a piston working therein, and interposed between the wheel, axles and frame, or between the frame of the truck and bearing bars that rest on the boxes in which work the journals of the axles.

Claim.—"I do not claim to have invented any of the parts described and employed in this arrangement when taken individually; but I do claim as new and of my own invention, and desire to secure by letters patent, the combination of a plurality, say of three or more, spiral springs, with a piston within a cylinder, the convolutions of such springs being alternately right and left handed; this combination of springs being applied in the manner set forth, or, for example, between the frame and bearing bar, for the purposes hereinbefore made known; the whole being constructed and arranged as described herein."

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16. For an improvement in the *Scraper for excavating Earth;* John Branson, Jr., Sangamond county, Illinois, March 18.

A curved plate of iron, having the lower edge made sharp, is secured to a standard, running down from a beam, and braced to the beam by two diagonal (iron) braces, (rods,) that extend from near the ends of the plate to the beam.

Claim.—"I do not claim as my invention the scraper plate, nor the frame, consisting of the handles, beam, &c., as these have been known before, when used separately. But what I do claim as my invention, and desire to secure by letters patent, is the attaching of a scraper plate formed in the manner herein described, to a beam and handle, by means of the upright and iron rods, so that the upper edge of the plate shall be at right angles to the beam, and shall not be permitted to turn as in the scrapers generally used."

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17. For improvements in the *Knitting Loom;* Arasmus French, Springfield, Mass., March 18.

These improvements are on that class of knitting machines in which the fabric is formed, one stitch or loop at a time, on a series of needles, projecting from a belt that passes around rollers. The first claim relates to the mode of making the chain or belt by a series of hinge joint links, one joint for each needle, so that the number of needles can be increased or decreased by simply taking out or inserting a joint pin for each needle that is renewed or added. The second claim relates to the mode of making the nippers of two springs, by which the thread or yarn is conveyed from the bobbin to the needles. The third claim relates to an arrangement of parts by which the action of the nippers is reversed, to reverse the direction of the knitting. And the last claim relates to an arrangement for retaining the chain of needles on the roller around which it passes by a lip above and a spring below.

We are under the necessity of omitting the claims, as they refer to,

and are wholly dependent on, the drawings; but we have above given the substance of them.

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18. For an improvement in *Friction Matches;* Stephen Blaisdale, Brunswick, Cumberland county, Maine, March 18.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the manufacture of friction matches by dipping the matches into a compound of sulphur and phosphorus, formed into a paste or fluid, by means of glue or any other glutinous or viscid substance as herein set forth."

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19. For improvements in the *Steam Engine;* Joseph J. Parker, Plymouth, Washington county, Ohio, March 18.

The reader will be able fully to understand the improvements for which this patent is granted, by referring to the following

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the mode of combining the sliding valves and steam chamber, the former being so arranged that when driven out they shall form heads for the steam to act against in operating the pistons, and also the mode of combining the valves of the two chambers by means of the chain and segment described, so that when one is forced out by the steam, the opposite valve shall be pressed in, as herein set forth."

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20. For an improvement in the *Spark Arrester;* John V. L. Hoagland, Jersey City, N. J., March 18.

The patentee says:—"The nature of my invention consists in carrying my funnel or chimney up through the outside casing, and giving the top of the funnel a bend or curve so as to arrest the sparks in their course, and direct them downwards to the bottom, by means of the concentric casing being of a semi-circular form, attached to the front of the outside casing, and concentric with the bend or curve of the top of the chimney or funnel."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the curved top of the funnel with the concentric casing placed in that or any other part of the chimney or funnel, which constitutes the whole of my claim, as is fully shown and set forth in the drawings and specification."

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21. For an improvement in *Ships' Anchors;* Wm. H. Porter of England, assigned to John Jenks Osborne, New York City, New York, March 18.

The two arms are made in one piece and jointed to the end of the shank, so as to turn thereon, the object of which is to prevent fouling the cable, and to prevent one of the flukes from projecting so high as to injure the bottom of the ship, for when one fluke is in the mud or sand the other will lie on the shank. Each arm is provided with a projection or second fluke on the outside, about mid-way between the point of the main fluke and the junction of the arms with the shank.

Claim.—"I would remark that I am aware that anchors have been before made with arms capable of movement on the shank or stem, I do not, therefore, claim the same generally; but what I do claim as my invention and desire to secure by letters patent, is the method of constructing the arms and flukes of the anchor with the projections, for the purpose and in the manner described."

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22. For a *Composition of Matter for covering Ships' bottoms;* Samuel Williams, New York City, New York, March 18.

The patentee says:—"The materials are varnish, boiled oil, arsenic, red lead, sulphur, and sugar of lead, to which may be added any ochre or other coloring substance, according to the fancy of the person using the same. The proportionate quantity of each material is as follows:

Half a gallon of varnish.
One quart of boiled oil.
Two pounds of arsenic.
Two pounds of red lead.
Half a pound of sulphur.
Half a pound of sugar of lead.

"To which may be added, if a copper color is required, one pound of yellow ochre, and a small quantity of lamp black. These several quantities of ingredients will make about a gallon of the composition. This composition is applied to the vessel while it is boiling hot, and with brushes, in the same manner as ordinary painting."

Claim.—"What I claim as my invention, and desire to secure by letters patent of the United States, is the peculiar admixture of materials in the manufacture of paint, or composition of matter, for covering the bottoms of ships and other vessels, in the manner and for the purposes above described in this specification."

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23. For improvements in the *Cooking Stove;* Thos. O. Sayre, Elizabethtown, New Jersey, March 23.

Claim.—"Having thus fully described the construction of my improved semi-circular cooking stove, and explained the manner in which the same operates, what I claim therein as new and desire to secure by letters patent, is

"First, The manner of arranging and combining the semi-circular oven-space with the semi-circular chamber of combustion and with the quadrant shelves, or carriages, and the circular ways by which they are guided and kept in place.

"Secondly, I claim the particular manner of forming the lining of the back of the semi-circular fire chamber, in part with fire-brick, and in part with pieces of cast-iron, in the forms here designated, so that they shall interlock, and under the arrangement specified, by means of which the heat of the oven-space will be rendered uniform, and its temperature such as to insure its perfect action.

"Thirdly, I claim the manner of constructing the combined swinging door and horizontal swinging semi-circular grate, arranged and

operating substantially as herein set forth; and these parts and combinations I claim, whether made precisely in the form herein designated, or under such variations thereof as may be dictated by fancy or by convenience, whilst the construction, arrangement and operation thereof remain substantially the same as herein set forth and made known."

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24. For an improvement in *Tailors' Shears;* Thomas Hawkins, assigned to James G. Wilson, New York, March 23.

The patentee says:—"The nature of my invention consists in allowing the under blade and bow of the shears to remain stationary, and having a sling joint connexion between the upper blade and bow; so that by raising the upper bow, the upper blade is thereby raised, and in depressing the upper bow, the upper blade is thereby brought down by means of a proper purchase formed by the stirrup connecting the sling joint, and made to cut upon the stationary under blade."

Claim.—"What I claim as my invention and desire to secure by letters patent, is the application to shears of the sling joint connexion, or any similar mode producing the same result, by which the upper blade is moved by the upper bow, and allows the under blade and bow to remain stationary, as herein described, using therefor any material which will answer the purpose."

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25. For an improvement in *Tailors' Shears;* Herman Wendt, New York City, New York, March 23.

A volute spring is introduced in the joint for the purpose of forcing and keeping the shears open, so that the operator has only to close them, by having one end of the spring attached to the joint pin, and the other to one of the blades. And to the forward part of the under side of the bow of the upper blade, there is a curved lip in which the fore finger rests, to give a greater purchase.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the addition of the concave curvilinear lip to the finger bow or handle, and the application of the spiral spring in the joint, the whole constructed, combined and operating substantially as above set forth."

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26. For a *Subterrane Bomb, or Shell;* James MacGregor, Jr., Wilton, Saratoga county, New York, March 23.

The patentee says:—"The nature of my invention consists in forming bombs or shells of cast-iron, which are to be charged in the manner of other bombs or shells, with gunpowder and such other matter or things as are used in the charging of such instruments, and providing such bombs or shells with a lock so arranged that they shall be discharged by the tramping of men, horses, or the passing of carriages over them; and in placing them under the surface of the ground where the troops or baggage of an army is expected to pass."

Claim.—"Having thus fully described the nature of my invention,

and shown how the same is to be carried into effect, what I claim therein, and desire to secure by letters patent, is having the powder for a mine confined in a cast-iron shell or case, and of constructing and combining thereto a lock that will operate by the passing of men, horses, or wagons over it, as above set forth; not, however intending to limit myself by this claim to the precise form of lock therein set forth, but to vary the same as I may think proper, while the same end is attained by means substantially the same."

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27. For improvements in *Cooking Stoves;* Jordan L. Mott, New York City, New York, March 23.

The bottom of the oven is composed of the upper surface of three horizontal tubes, the middle one larger than the other two. The products of combustion pass from the fire chamber over the oven down two side flues at the back, into the two side tubes at the bottom, then in a flue space at the front end of these tubes, thence back through the middle tube, and up the middle back flue to the chimney. These horizontal flue tubes are cast together, with a connecting plate at each end, which form, by appropriate flanches, the connexions with the several flue spaces, so that they can be readily removed for cleaning.

Claim.—"Having thus fully described the nature of my improved tubular oven cooking stove, and shown the manner in which I connect and combine the several parts thereof, what I claim therein as new and desire to secure by letters patent is, first, the combining, in the manner set forth, of two, three, or more tubes, which constitute the lower oven flue or flues, with the flue or boiler space over the oven, with the descending and ascending flues at the back of the oven, and with the flue space into which the fore ends of said oven flues open.

"I claim also the manner of arranging and combining the lower oven flues together, by means of the end pieces and collars, so as to render them removable at pleasure, for the purpose of cleaning or repairing them And I do not intend to limit myself to any particular form or construction of the stove, or cooking apparatus, in which I apply my tubular flues to constitute the lower part of the oven, but I claim the using or combining them, substantially in the manner set forth, with any kind of cooking stove, cabouse, or range which is furnished with an oven or ovens, and in which they can be conveniently employed."

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28. For an improvement in *Over Shoes;* Daniel Hodgman, New York City, New York, March 23.

This is for inserting a metal plate in the heel part of the over shoe, that carries a nut, through which passes a pointed thumb screw, by which the over shoe is secured to the heel of the boot.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the inserting a screw into the counter of an over shoe, in the manner and for the purpose above described."

29. For a *Composition for rendering Cloth, &c., water-proof, without losing the pliability;* Nathaniel Hatch, Eastport, Washington county, Maine, March 23.

The following is extracted from the specification, viz:—"Take half a pound of gum shellac, and one pint alcohol, and put them in a tin kettle with a cover, and suspend the kettle with said contents in a boiler of boiling water, and keep the heat up till the gum dissolves, then put one quart of boiled linseed oil in the kettle with the shellac, and boil them together till they are well mixed. Secondly, take one ounce of India rubber, cut it in very small pieces, and one quart of spirits of turpentine, and put them in another tin kettle with a cover, as before named, and suspend it, with the contents, in a boiler of boiling water, and keep the heat up till it is dissolved; then put two quarts of boiled linseed oil in the kettle with the rubber, and keep the heat up till they are completely mixed. Thirdly, take one pound of yellow hard soap, and two quarts of water, and boil them together till the soap is all dissolved.

"Then to make the composition, take 8 lbs. white lead ground in oil, 1 gill coal tar, 6 ounces lamp black, 1 lb. gold litharge, 4 quarts boiled linseed oil, 3 quarts of the above named solution of India rubber, 1 gill of the solution of shellac, as above named, 1 pint of copal varnish, and mix them all well together. Then put one quart of the soap and water in the composition while the soap and water are boiling hot, and stir them together till the whole is completely mixed together, and then apply the composition to the cloth with a common paint brush, and when the cloth is nearly dry, so that it will not rub off, apply the second coat of the composition, and when the second coat is nearly dry, apply the third coat of the composition, which makes the cloth water-proof and pliable. If I want to make any other color, I put other colored paint in, enough to make such a color as I want, namely—to make yellow, I take chrome yellow; or for green, I take chrome green; and to make white, I leave out the lamp black, &c."

Claim.—"I claim as my invention, the compounding of the several articles as mentioned above, and in their several proportions there described, for the formation of a composition which, when put on cotton or linen cloth, renders it water-proof without losing its pliability."

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30. For an improved *Doubled-flued Stove or Grate;* David Petree, Little Falls, New York, March 23.

The patentee says:—"The nature of my invention consists in providing and locating a flue just at the top of the coal or wood grate, and a gas-blower or cover to the grate swinging from the top of that flue, so as to rapidly ignite the coal, and effectually to carry off deleterious gas, so that none of it shall escape into the room, by means of which improvement, any description of combustible material may be used without any unhealthy or unpleasant effect whatever. In addition to that advantage, this stove possesses the virtue of affording a very large degree of heat from a comparatively small quantity of fuel,

also of producing a quick as well as durable fire from a given quantity of fuel."

Claim.—"What I claim as constituting my invention in the within described double-flued stove, is the manner in which I have combined the movable cover with the grate and with the damper, for the purpose of allowing a fire to be kindled below said cover, and thus preventing the escape of gas from the fire into the room; the whole apparatus being constructed and arranged substantially as set forth and described."

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31. For an improvement in the *Windlass;* William Holmes, Baltimore, Md., March 23.

We are under the necessity of omitting the claim, as it refers to, and is dependent on the drawings. It is limited to a peculiar manner of constructing the parts by which brake-levers are applied to the windlass.

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32. For an improvement in the *Propeller for Ships;* Daniel Rudd, Bozrah, New London county, Connecticut, March 23.

A series of blades are jointed together, (and for a short distance slide into each other,) and to a series of cranks—there being one crank for each joint, and on the crank-shafts there are segment wheels connected together by cords, or chains, by means of which the cranks receive a reciprocating, vibratory motion, in opposite directions, which communicates to the series of blades a continuous sculling motion.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the continuous jointed scull, moved by the cranks, &c., combined and arranged in the manner and for the purpose herein described."

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33. For an improvement in the *Bridle for Horses;* John C. Smith, Brookhaven, New York, March 23.

Claim.—"What I claim as my invention and desire to secure by letters patent, is attaching the lower ends of the reins to the martingale strap, or other secure part of the harness, near the fore part of the animal, and passing the other ends over pullies attached to the rings of the bit, in the manner set forth, or in any other mode substantially the same."

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34. For an improved method of *Spinning*, by which a thread is spun of one kind of material and covered with another; Moses Chase, Baltimore, Maryland, March 23.

A thread, say of cotton, is received from a bobbin and passed between two rollers that receive a thin sliver of wool from a carding machine, and from these rollers the thread is carried to a flyer, the rotation of which winds and spins the woolen sliver on to and covering the cotton thread.

The claim, which we are under the necessity of omitting, is limited

to the arrangement of the carding engine, with a series of flyers, to produce this result.

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35. For an improvement in the *Ditching Machine;* C. R. Bartlett, Genesee, Illinois, March 23.

Without drawings to illustrate this improvement, the claim could not be understood ; it relates to an arrangement of the cutters for forming the bottom and sides of the ditch, and the angular trough which carries up the earth to form the embankment.

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36. For an improvement in the *Machine for Cleaning Grain ;* J. N. Bird & E. D. Weld, Trenton, New Jersey, March 28.

This improvement consists in passing the upper end of the shaft (designated in the claim by the letter K) of the beating cylinder through the hub of the fan blower, placed above and operated by a separate pulley, so that the cylinder beater and the fan can be turned in opposite directions.

Claim.—" What we claim as our invention and which we desire to secure by letters patent, consists in the mode of combining the fan on the upper end of the revolving cylinder with said cylinder, viz: by constructing it with a hollow axle, through which the shaft (K) passes, and providing it with a separate pulley, arranged immediately below the pulley, for driving the aforesaid cylinder, by means of which arrangement, a greater velocity, and in a contrary direction may be given to the fan than if fixed permanently on the shaft (K,) as heretofore, or allowing, if necessary, by means of a broad band, of their being driven together in the same direction, all as herein set forth."

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37. For an improvement in the *Lamp for burning Camphine and other essential oils;* Charles Carr, Philadelphia, Pennsylvania, March 28.

Claim.—" Having thus described the nature of my improvement in the lamp for burning spirits of turpentine, camphine, and other essential oils, what I claim therein as new and desire to secure by letters patent, is the manner in which I have constructed, arranged, and combined the rack and pinion, the wire, the wick holder and the burner, so that the outer tube of the burner shall be continuous at its upper end, whilst the wick holder shall have the requisite play up and down, not only for the purpose of combustion, but also for the supply of new wick, when requisite, said wick holder being permanently retained within the burner; the respective parts being constructed and operating substantially as described."

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38. For an improvement in the *Plough for Prairie Lands ;* Cromwell K. Bartlett, Geneseo, Henry county, Illinois, March 28.

Claim.—" Having thus fully described the manner in which I construct and use my prairie plough, what I claim as my invention and desire to secure by letters patent is the forming of the main body of

the wood work thereof of a plank which is to run on the ground, in the manner herein set forth, and having combined with it a share, coulter, mould-board, and landside, the operating parts of which extend below the bottom of the plank to the depth of the intended furrow. I claim the forming of the share, coulter, and landside of one continuous piece of metal, but at right angles, in the manner and for the purpose herein fully made known. I claim the manner of combining and arranging the timber and the share, coulter and mould-board of the plough so as to constitute one piece by their combination with each other, which combined piece may be adjusted so as to regulate the depth of the furrow by means of screws and nuts, or other devices, substantially the same with that described."

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39. For an improvement in the *Argand Lamp;* Daniel Pettibone, Philadelphia, Pennsylvania, March 28.

Claim.—"The invention claimed and desired to be secured by letters patent, is constructing the lamp with a middle revolving cylinder, ribbed on its inside and contracted at top, with a shoulder and ring for turning said cylinder, in combination with the spiral thread on the surface of the inner cylinder, over which the wick is placed for raising or lowering the wick as herein set forth."

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40. For an improvement in the mode of applying the *Elastic Force of Steam, Gas, &c.;* Henry Pratt, of Great Britain, but now residing in the United States, March 28.

Claim.—"Having thus fully described the nature of the apparatus used by me for applying the elastic power of steam, or of gases, or of the pressure of a column of water to the propelling of machinery, and having likewise set forth the manner in which I construct my condenser when steam is employed, what I claim as new therein and desire to secure by letters patent, is the forming of one, two, or more helical passages within the periphery of a cylindrical revolving body which passages are to ascend gradually from the lower to the upper part of said body, and said passages having one of their sides formed into steps or offsets in the manner set forth, for the producing of a powerful friction and resistance to the passage of a fluid through them, in the manner and for the purpose set forth. I also claim the reversing of the direction of these channels just before the fluid escapes therefrom. I claim also the within described manner of constructing and arranging the respective parts of my cold air condenser, said condenser consisting of a series of conical frustrums of sheet metal placed within a vertical metallic case; said conical frustrums being formed and operating in the manner set forth and being combined with the lower vessel substantially in the manner described. I also claim the coating or covering of the exterior of the several conical frustrums and other parts as described for the purpose of increasing the surface upon which the air may operate. I have spoken of the revolving body in my power machine as placed vertically, but it

may be placed horizontally, or the operating fluid may descend instead of ascending through the convoluted channels, and other variations may be made in matters of detail. I do not therefore intend to limit myself to the precise form and arrangement herein given, but to vary these as I may think proper, whilst the principle and the effects produced remain substantially the same."

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41. For an improvement in the *Thumb Latch;* Edmund Parker, Meriden, Connecticut, March 28.

The opening in the handle plate through which the thumb latch passes is enlarged diagonally so that the thumb piece can be introduced, and when introduced turned to occupy its proper place, with an enlargement within and without to avoid the necessity of a fulcrum pin—the diagonal enlargement being sufficiently large to admit the shoulder which retains the thumb piece when turned in a vertical position.

Claim.—"What I claim as constituting my improvements in the thumb latch is, first, the forming of the opening in the plate in a direction standing at an angle with the opening and of such length as to allow the shank of the thumb piece to pass entirely through it, and in adapting these parts to each other, in the manner set forth, so that by rotating the thumb piece it will be made to occupy the part of said opening."

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42. For an improved *Apparatus to be used in Copying Statuary, &c.;* Henry Dexter, Boston, Massachusetts, March 28.

The statue to be copied is placed upon a turning platform graduated on its periphery and the block to be cut is placed upon a like platform, and by the side of each platform there is a vertical graduated rod having a slide through which passes a graduated pointer—by means of these the sculptor or carver can take the most accurate measurements.

We are under the necessity of omitting the claims as they could not be understood without the drawings.

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43. For an improvement in *Light Houses;* Aaron Folger, Nantucket, Massachusetts, March 28.

This is for arranging the lamps and reflectors all around, and so near to the glass of the lantern as to heat it by radiation, and thus prevent frost or condensation of vapor on the glass.

Claim.—"What I claim is the following, viz: the position of the lamps in such contiguity to the glass of the lantern as will keep a temperature to that effect; this may be done by placing them on any proper line of distance between the glass and six inches of the glass, as the size and shape of the lamp and reflectors may require, the distance from the glass being mostly governed by the size and shape of the reflectors and in the manner described in the specification or any other manner that is substantially the same."

44. For an improvement in the *Galvanic Battery;* Patrick Coad, Philadelphia, Pennsylvania, March 28.

Claim.—"What I claim as my invention and which I desire to secure by letters patent, are the modes of depression and elevation of the galvanic battery and the graduation of said battery and galvanic trough, so that the intensity of the effect produced may be varied. I do not claim to be the inventor of the metallic cylinders, or the screws by which the wires are attached to said cylinders, neither do I claim to be the inventor of the glass handles with the metallic screws partly through, but I do claim as my invention the attaching of the glass handles to the metallic cylinders in the manner and for the purposes specified."

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45. For an improvement in *Daguerreotype Impressions;* B. R. Stevens & S. Morse, Lowell, Massachusetts, March 28.

The patentees say:—The nature of our invention consists in preparing the metallic plates on which daguerreotype impressions are to be taken so as to fix the impressions on the plates and adapting them to the reception of colors by coating the same with varnish or solutions of gum.

Claim.—"What we claim as our invention and desire to secure by letters patent is the mode of preparing daguerreotype impressions so as to fix them on the plate, and adapting them to the reception of paints and colors by coating the same with varnish or solutions of gums; using for the purpose of coating said plates, any kind of varnish or gum, or any preparation of varnish or gums, which will produce the intended effect."

MECHANICS, PHYSICS, AND CHEMISTRY.

Description of an Automatic Dividing Machine, arranged for use in the Coast Survey Office, by JOSEPH SAXTON, *Assistant in the office of Weights and Measures, Washington, and constructed by William Würdeman, mechanician, Coast Survey Office.*

(With an engraving.)

The dividing machine, which has been rendered automatic by Mr. Saxton, was imported for use in the Coast Survey office by the late F. R. Hassler, Esq., superintendent. The graduations made by means of it by different persons were unsatisfactory. Many causes were assignable for this, and it was considered by the present superintendent, Professor A. D. Bache, desirable that the most obvious of the causes of error should be got rid of, by rendering the machine automatic, before the minor causes of irregularity were sought for. This was done by Mr. Saxton, in the manner described in the following pages. The result has been very successful, not only in its first application, but in permitting the determination and removal of sources of error, previ-

ously concealed in the working of the machine. The drawings of the proposed additions upon a scale necessary for working were made by Mr. Saxton, and the work was executed by Mr. William Würdeman and his assistant mechanicians in the Coast Survey office. Accuracy, beauty of finish, ease of reading, economy of time and labor in dividing, have all been gained by the improvements.

The machinery for rendering the dividing machine automatic, consists of a brass wheel A, about 20 inches in diameter, mounted on the axis B, (fig. 1, Plate IV.) One of the arms of the wheel A, has a slit extending from near the centre of the rim; in this slit is fixed the crank-pin so that it can be placed at any required distance from the centre. On the edge of the wheel is turned a groove in which runs a cord for driving the wheel. On the other end of the axis is fixed the wheel C, which is geared into the wheel D, on the lower end of the vertical shaft E, (fig. 2.) On the upper end of the same shaft, is another wheel, F, geared into the wheel G, on the horizontal shaft H. On the end of the shaft H is a wheel I, which gears into the wheel J, on the axis K. The wheels C, D, F, G, I and J are all bevel wheels, having the same number of teeth, (60,) and work into each other at right angles.

The shaft E has on it a sliding joint L, for altering its length; the shaft H is turned and ground of uniform thickness, so that it may slide accurately through the socket of the wheel G, and also through its bearing at M, in which it turns. The axis K has on it two eccentrics, N and O. N to raise the tracing point, and O to move it horizontally. One half of the circumference of N is concentric with the axis on which it turns, so as to keep the point up while the crank-wheel moves half a revolution, and is moving the dividing plate. The other is eccentric to the axis about $\frac{1}{10}$th of an inch, so as to let the point rest on the circle while it is making the division. The eccentric O has about $\frac{1}{8}$ of its circumference concentric to the axis; the rest is described from a point about $\frac{1}{8}$ of an inch from the centre. N and O must be fixed on the axis with regard to each other, so that N will raise the point before O begins to move it back, and both with regard to the crank-wheel A, so that the point will be raised before the crank begins to move the dividing plate, and keep it up until it is done moving, and O has moved the point back, and then let it down before O begins to let it return. The axis K has also on it, near the end, a small cog P, to shift the ratchet-wheel Q one tooth every revolution of K. The ratchet-wheel has 60 teeth, and is kept in its proper position by the detent spring R. In front of the wheel, and fastened to it by two screws, is a circular plate S, (figs. 1 and 3,) with 20 notches in its edge, the deepest one for the longest line, or 5°; the next for 30′; and the shallowest for 15′; and the edge of the plate for the 5′ lines.

The segment T, (figs. 1 and 3,) is fixed on the vertical part of the tracing frame U, and has a pin in the end, at V, of such a size that it can drop into the notches in S, as they are brought under it by the revolutions of the ratchet-wheel, and so regulate the length of the division lines. The time of raising the ratchet must be when the stop pin is raised out of the notch by the motion of the traces back-

wards. To give motion to the screw, a stout fusee chain is used, $\frac{1}{8}$ of an inch broad, and $\frac{1}{14}$ of an inch thick, which answers well; one end is attached to the ratchet-barrel W, round which it is wound five or six turns, the other end is attached to the crank pin X. Near the lower end of the chain, at Y, is a small tube, containing a strong spiral spring, arranged like the common spring weighing machine, but having a motion of only about $\frac{1}{8}$ of an inch; the spring must be so strong as not to give by the force required to turn the screw, but only to give a little when the ratchet comes up to the stop, and the crank is just passing the lower centre. Between the spring and the crank-pin is an arrangement for lengthening or shortening the chain when it is arranged for making a larger or smaller division; for this purpose, two pieces of brass wire, about six inches long, having a screw cut on them their whole length, and each filed away one-half, and two small milled nuts, tapped with the same thread, are run on each; the two wires are laid together, and the nuts screwed up until they embrace both wires, as shown at Z, (fig. 1.)

The crank-pin is fixed on a slide projecting beyond the nut which fastens it, so that it may be extended, if necessary, beyond the circumference of the wheel, or by reversing, it may be brought quite to the centre; when the divisions are to have the long end towards the centre, a jointed lever, as shown at *a*, (fig. 3,) is used, it is screwed fast to the cross bar *b*, (figs. 2 and 3,) directly over the eccentric O, and connected to the vertical frame U at *c*, and the stop pin V is shifted to the other end of T, and the abutting piece *f*, on U, is to be removed, when the eccentric O will act against the lever *a*, at *d*, and move the point in an opposite direction. The tracing-frame is made to follow the eccentric by a weight and cord passing over a pulley and hooked to the vertical part of the tracing frame at *e*, *e*, (fig. 3.)

When the adjustment is made for dividing with the long end of the division lines, towards the circumference of the circle, all the wheels connecting the axis K with the axis B should be marked with a dot on the tooth and space in which it works, and a line should be drawn on the shafts E and H, and a corresponding mark on the sockets through which they pass, so that they may always be fastened in the same position. The axis K should have two short pins fastened on it, and notches in the ends of the sockets N and O, to fix them in their proper position when the lines are towards the circumference or centre, as the case may require. The slit in the crank-wheel A, in which the crank-pin is fastened, should also be graduated, showing the distance of the pin from the centre, for each degree, minute, and second that may be required in dividing.

By marking the position of each part of the machine in this way, much time and trouble will be saved in making the necessary changes for different kinds of dividing, whether it be in the number, or the direction in which the long lines are to be extended. The tracing point should be adjusted so as not to be raised more than about the thirtieth of an inch, or it will be liable, in descending, to make a small dot at the commencement of each line, which would injure the appearance. In the drawing, the eccentric N is represented as acting on the tail of

SAXTON'S AUTOMATIC DIVIDING ENGINE.

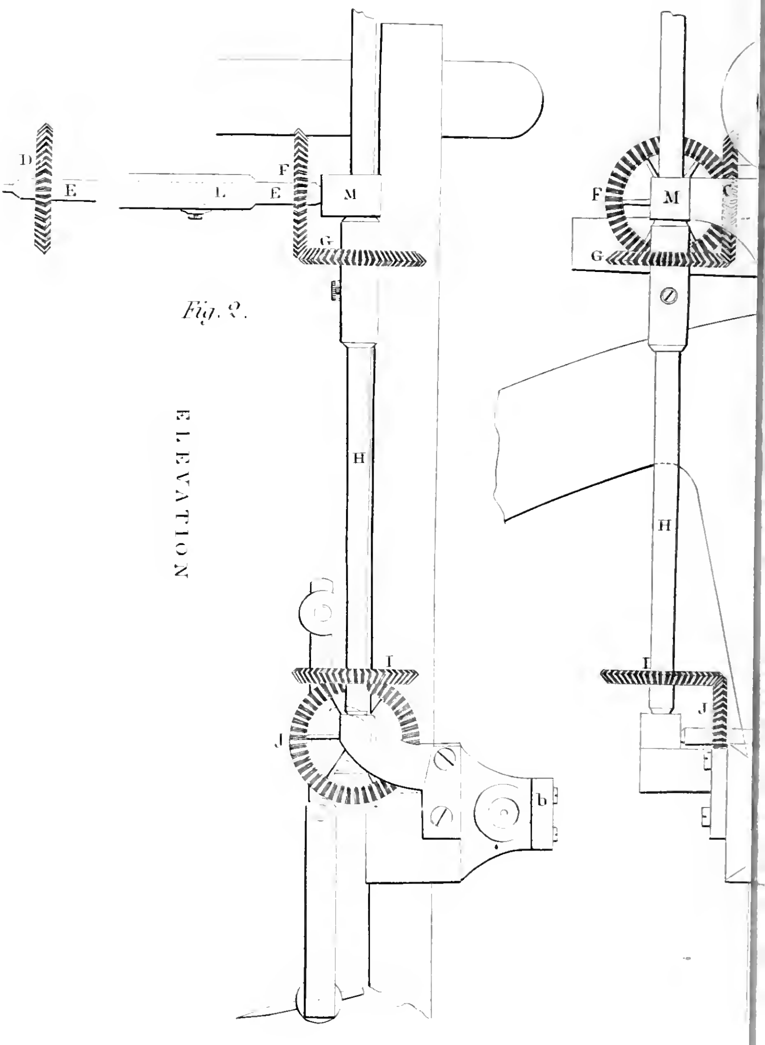
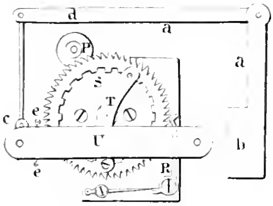


Fig. 2.

ELEVATION

Fig. 3.



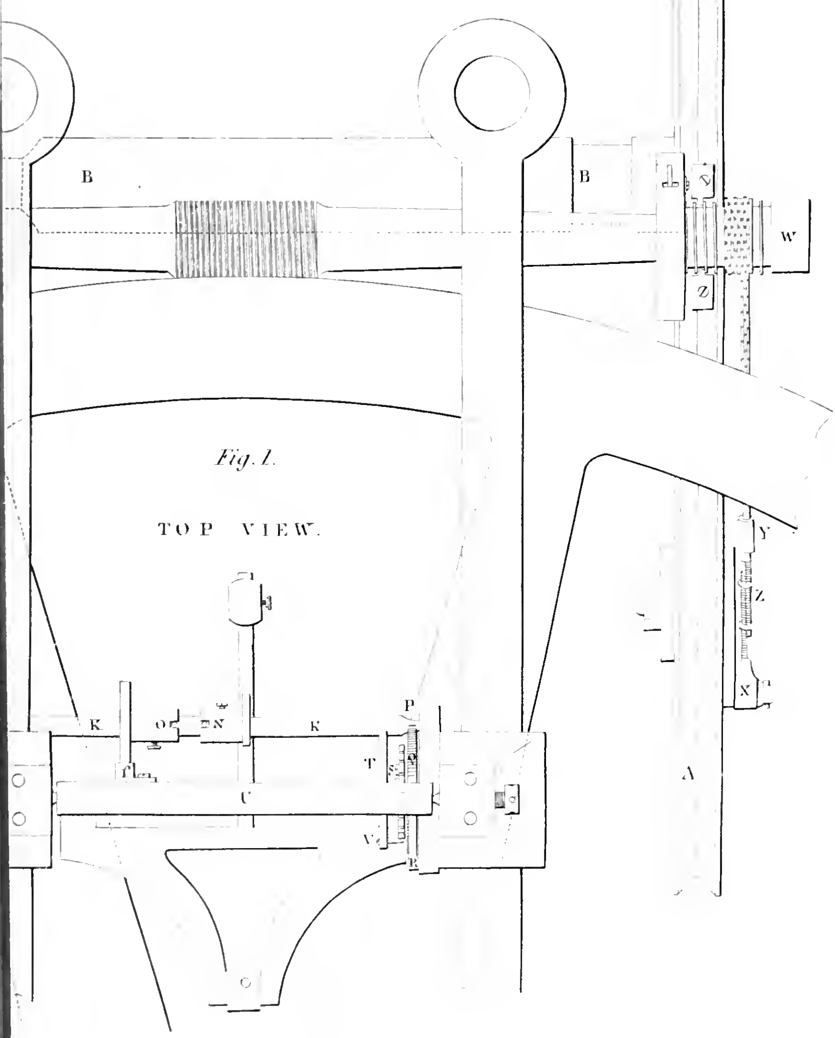


Fig. 1.

TOP VIEW.

the tracing-frame, but it is better to make it act on a steel pin in the side of the tail.

By this arrangement of the crank for turning the dividing screw, the stops of the ratchet are brought in contact when the crank is passing its centres, and the motion of the screw so slow that it is not possible for the stops to strike so hard as to do any injury, and the dividing may be done with great rapidity.

Observations on the more recent researches in the Manufacture of Iron. By Dr. J. Lawrence Smith, of Charleston, S. C.

(Continued from page 204.)

In the last article on this subject, the operations of the blast furnace alone were alluded to, and among the statements then given, was that of the composition of the gas taken from the mouth of the furnace; which gas contained about 24 per cent. of carbonic oxide, this representing a large portion of the combustible used, which is lost in most of the furnaces now in operation in this country.

M. Ebelman states that the combustion of the gas passing from the mouth of the blast furnace is equal to from $\frac{62}{100}$ to $\frac{67}{100}$ of the calorific effect of the coal used, and MM. Bunsen and Playfair set it down as $\frac{90}{100}$ which last, I am rather inclined to believe, is rather too large a fraction; they spoke of the furnace worked with bituminous coal, and Ebelman had allusion to one worked with charcoal. Without being able to decide exactly what portion of the combustible of the blast furnace is lost, it is sufficient to know that it is far greater than that consumed, to lead at once to the employment of means bringing into use this waste combustible.

The employment of heat lost from the mouth of the blast furnace, for the purposes of metallurgy, &c., has been claimed by many as having been used by them since 1834. The following are some of the claimants:—MM. Thomas and Laures, (civil engineers;) MM. d'Andela-re and de Lisa, (forge masters at Treveray;) M. le Marèchal Marmont, (in Austria;) M. Houzeau Muiren, (of Ardennes;) and M. de Faber Dufaur, (of Wasseralfingen.) All their claims of priority, however, ought to be laid aside, since the operation was performed many years prior to the time that any of them claim to have first employed the lost heat. And as a proof of this assertion, I give the following extract from the Journal des Mines, Juin, 1814.—"M. Aubertot, of the department of Cher, and owner of furnaces and other works in excellent condition and management, which he superintends personally, made, several years ago, a great many experiments to discover some means of economizing the amount of fuel used in the working of iron, either by endeavoring to introduce the operation by the catalan furnace, or otherwise. He was led to try what could be accomplished by making use of the flame which passed out of the blast and refining furnace. He first employed it for the cementation of steel, in which he succeeded perfectly; then he used it for calcining lime, also for burning bricks and tiles. Afterwards he passed it into

a reverberatory furnace, in which the temperature was raised sufficiently to heat the blooms and bars, for hammering the one and drawing the other out. Finally he succeeded in producing all the above effects at one and the same time, by causing the flame to circulate through several furnaces side by side."

In 1834, M. Houzeau Muiren took out a patent for using the waste heat from the mouth of the blast furnace, for carbonizing wood at the furnace of Bievres, (Ardennes;) in which he states that twice the quantity of charcoal is obtained by treating the wood after his method, than by the ordinary way of burning in the woods. By the heat lost from the furnace, 100 parts of wood gave 35 of charcoal, and from 40 to 45 of *charcoal roux* (half burnt wood.)

But after all, it is not to those who first applied this lost heat to economical purposes that we are indebted for the practical information that is now in our possession; for had they made their arrangements so as to exhibit an undisputed advantage arising out of its adoption, it would not have been so tardy in its progress.

It is to M. de Faber Dufaur, superintendent of the iron works at Wasseralfingen, in the kingdom of Wurtemburg, that most of the credit is due for the present method of converting pig into wrought iron, by using and burning the gases that escape from the mouth of the blast furnace. The best idea that can be given of the manner in which the operations are conducted in the above works, and the advantages accruing therefrom, is contained in the following short extract from a letter written by M. Grouvelle to M. Dumas.*

"The establishment at Wasseralfingen is supplied with ore, three-fourths of which is a hydrated oxide of iron, and the other fourth is an ore in grains. The influence of the first species of ore gave to the pig so bad a quality that it was used altogether for castings. M. Dufaur, by his processes, without altering the operations of the blast furnace, now obtains from the pig a wrought iron of superior quality.

"The first gas furnace put in operation by him was a refining furnace, into which the pig metal was run as it issued from the blast furnace, where the refining was executed with the air of the hot blast. From this the most beautiful results were obtained, and it worked regularly during the year 1837. In 1838, he erected a puddling furnace; and finally, in 1839, he completed his magnificent system for the fabrication of iron, by constructing a furnace for re-heating and welding."

At Wasseralfingen there are now turned out annually, one million pounds of wrought iron in various forms, made in these new furnaces, and owing to the deficiency of moving power, all the pig cannot be worked up. This operation of refining iron by the combustion of gas without any other fuel, has been in successful operation at the above locality for several years, and it has been followed with a great improvement in the quality of the iron, and has reduced the loss to one-fourth of what it was originally.

This method of refining the pig has also been in active operation in

* Comptes Rendus, 1841, p. 382.

a number of places, and whenever properly executed, is always attended with economy and success. M. d'Andelarre, in one of the departments of France, in a letter states, "our puddling furnaces, heated altogether by the gas lost from the mouth of the blast furnace, has been attended with the most complete success, which rarely happens in the first attempts at the application of any improvement, which most generally require long experience. We lighted up our furnace on the morning of the 5th, and put in the first charge at 11 o'clock on the morning of the 6th, and shingled the same at three-quarters past twelve. The accomplishment of the results so quickly passed our expectations, resulting in

"1st, An economy of the total amount of fuel used in the refining of iron, (which, in a furnace with two doors, amounted, in 24 hours, to 6,000 pounds bituminous coal, costing twelve dollars.)

"2d. Improvement in the quality of the iron.

"3d. The loss was very small, being 5 instead of 20 per cent., which it is by the old processes.

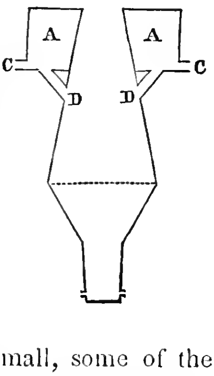
"4th. The operations of the furnaces are much improved."

Here we see that the experience of M. d'Andelarre accords exactly with that of M. Dufaur, and already have Russia, Prussia, Sweden and Germany sent commissioners to Wasseralfingen, to study the processes as they are there carried on. The government of Wurtemburg have opened their works to the inspection of all who may wish to make themselves acquainted with their character.

The advantages arising from the employment of the waste gas from the mouth of the blast furnace, is no longer problematical, and as some of those interested in this matter may not be acquainted with the method by which the gas is collected and employed, a few words explanatory of it will not be out of place.

The gas, as it rises through the fire room of the furnace, containing from 60 to 80 per cent. of the combustible effect of the fuel used, is made to pass into a chamber surrounding the upper and outer part of the fire-room, some idea of which may be formed by the representation in fig. 1. B, is the mouth of the furnace; A, A, gas chamber surrounding the upper part of the fire room; D D, pipes connecting the fire room and gas chamber; C, C, pipes to carry off the gas, which is drawn out by means of blowing cylinders and forced into the refining, puddling, or other furnace, through a number of small orifices alternating with other orifices, through which a cold or hot blast of air is thrown that serves to keep up the combustion of the gas when once united; and by regulating the supply of air by means of stop-cocks, the maximum of heat can be obtained. In order to arrive at the maximum of heat, just sufficient air should be admitted to burn all the carbonic oxide and hydrogen contained in the gas coming from the blast furnace. If the amount of air be too small, some of the combustible gases pass out unconsumed; if too great, the excess cools

Fig. 1.



the furnace, and at the same time oxidizes the metals undergoing refining. The regulation of the supply of the blast is of the utmost importance, and is said to be easy of accomplishment.

The differences between the reverberating furnaces worked in this way and those in which coal is used, is that carbonic oxide with a little hydrogen is the fuel, and it is burnt by a full supply of air. It is hardly necessary to say more of the advantages that are to arise out of this important change in the working of iron; for there is no expense for fuel in the refining of the pig, as the gaseous combustible issuing from the mouth of the blast furnace is more than sufficient to refine all the pig made from the furnace. The quality of iron is also improved, as none of those impurities contained in the coal and other fuel can interfere in the working of the iron.*

The sooner these modifications are introduced into our furnaces, the sooner will we be able to place iron in the market at a price to compete with that coming from any other quarter of the world, and entering our ports free of duty; at the same time it will increase the value of those works whose wood-land has been diminished by a too rapid and improvident use of fuel.

I next pass on to make a few remarks about the *refining furnace* used in the working of iron. In these furnaces the air is thrown, by one or two tuyers, into a crucible filled with charcoal, into which the pig to be refined, along with scraps coming from previous operations, is placed in a certain relative position. The change that takes place by the reaction of the air upon the coal, is similar to what occurs in the lower part of the blast furnace, namely, the conversion of the oxygen into carbonic acid, which is immediately changed into carbonic oxide. The analyses of the gases taken from the centre of the furnace, prove that the trasformation of the oxygen into carbonic acid corresponds to the position where the workmen constantly place the iron that is about to be forged, and this is just what we should expect as it is the point of maximum temperature.

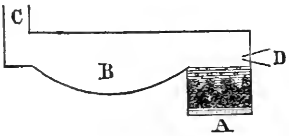
Ebelman states that the atmosphere which surrounds the melted iron, contains hardly a trace of carbonic acid, either in the blast or puddling furnace; this being contrary to the opinion which is generally admitted, that the decarbonization of the iron takes place by the action of the air during the melting of the pig, but it would appear that this reaction is attributable to the protoxide of iron covering the surface of the mass undergoing refining. In the second period of refining, in the puddling properly speaking, it is easy to deduce from the analyses of the gas, that there is oxidation of a considerable portion of the iron by the oxygen of the air thrown in at the tuyere.

Here again much of the fuel passes off under the form of carbonic oxide, thereby causing considerable waste. Of late years a modification has been introduced into the refining furnaces, even when the waste gases from the blast furnace are not employed; a modification by which none of the combustible is lost. A few words will suffice to explain how this is accomplished.

* If I mistake not, the Dufaur patent has been taken out in this country by Mr. Detmold, and has already been applied to one or two furnaces.—J. L. S.

All the furnaces are modifications of the reverberatory furnace. The fuel is placed upon the grate A, (fig. 2,) and ignited by air thrown in from below the grate, by a bellows or otherwise. The air in traversing the ignited coal is first converted into carbonic acid, and then, if the bed ofcoal be thick enough, this last will be changed into carbonic oxide. As this, however, is generally not the case, a part of the carbonic acid passes beyond the upper surface of the fuel without having undergone a change, particularly if the blast from below has been strong and abundant. By this operation the chamber B becomes heated, and a mixture of carbonic acid, carbonic oxide, nitrogen, and a little hydrogen passes out of the flue C. The object of the metallurgist, however, is not to permit any carbonic oxide or hydrogen to escape combustion, but to endeavor to add to the heat of the furnace that heat arising from the combustion of these two gases. This is readily accomplished by throwing in a second blast of air, through a number of small orifices just above the surface of the fuel, D; this blast to be regulated as required.

Fig. 2.



By this process, we re-create, as it were, the maximum intensity of heat, (which first shows itself at the lower part of the fuel on the grate, just where the air becomes converted into carbonic acid,) and in the chamber B, where it is most wanted; for the amount of heat rendered latent by the reduction of the carbonic acid into carbonic oxide, is rendered sensible by the reproduction of the former.

The advantages arising from this method of burning the fuel, are important. In the first place, the heat is diffused over a larger space, thereby heating more uniformly the metal, than when it is placed in the midst of the fuel. Again, fuel of the most inferior quality can be made use of, and as evidence of this in some trials made at Audincourt, it was proved that the reverberatory furnace could be heated to whiteness by burning the gas, and the pig melted and puddled, when a mixture of charcoal dust and earthy matter was made use of as fuel.

Ebelman, whom I have so often quoted in these articles, and who has certainly made the best series of scientific researches upon the subject, says that, instead of employing the action of air upon an excess of charcoal to produce the combustible gas, the vapor of water may, to an extent, be substituted, which produces, in contact with burning charcoal, carbonic oxide and hydrogen.

The heat of the combustion of equal *volumes* of hydrogen and carbonic oxide is about the same, and it can be easily deduced that the decomposition of the vapor of water by the charcoal, determines an absorption of latent heat, equal to that which is produced by the transformation of the same volume of carbonic acid into carbonic oxide. The vapor of water alone passed through the ignited coal produces all the effects just mentioned, but the absorption of latent caloric is so great as to cause the operation to cease in a few minutes. By projecting, however, a mixture of air and the vapor of water through the coal, the operation is said to be carried on advantageously.

It was my intention to have remarked at length about the effects of the hot blast, but it is now so generally admitted that the hot is to be preferred to the cold blast in reducing the iron from the ore, and bringing it to its most refined state, that any thing on the subject at this time would be superfluous. All that is important to make known upon this subject, is the results lately arrived at by M. Scheerer* as to how it is that hot air produces such remarkable effects in the blast furnace.

By calculations based upon his own experiments as well as those of others, he was led to the conclusion that the most elevated temperature that charcoal could produce in burning in air, is 2571° Cent., which is that at which platinum melts. This temperature is situated in the middle of the space upon which the air is projected, and it goes on diminishing towards the exterior, so as to form a space for melting, the centre of which is at 2571°, and the exterior at 1550° Cent. When the hot blast is made use of, the temperature of the centre does not change, but the portion heated to 2571° becomes more extended. The exterior of the mass, which was at 1550° while using the cold air, acquires, when the hot blast is employed, a temperature as many degrees higher as there is difference between the temperature of the two blasts; for instance, if the temperature of the air be 280° C., that of the exterior of the heated mass will be 1830° C.—if 300° C., the latter will be 1850° C.

Thus the influence that hot air exercises, is to extend the space of fusion, which is twice as great with the air at 300° C. as it is when the air is at 0° C. Amer. Jour. of Sci. and Arts.

Statistics of the Coal Trade.—The Coal Measures of Britain.

The coal measures are not confined to the north of England, in Northumberland and Durham; they are to be found, fortunately for this country, forming large portions of the stratification in many districts of the three kingdoms. From the Grampians to Sussex, and from the German Ocean to the Irish Sea, the predominating geological feature of the British island is the "carboniferous series," with the most magnificent coal deposits accessible in every direction. These have been the source of Britain's internal riches, and the great cause of the development of the mechanic arts, which distinguish her above all other countries. Had the granite of the Grampians, it has been said, and said justly, extended into Sussex, or the chalk of Sussex to the Grampians, the whole course of British History would have been changed. Nineteen of our most important manufacturing cities, which lie upon the new red sandstone, drawing from beneath them the coal, iron, and lime—the sources of their manufacturing prosperity—in either case, it is probable, would never have existed.

In Ireland, the coal measures exist in the provinces of Munster, Leinster, and Ulster; in Clare, Limerick, Monaghan, and Kilkenny.

In Scotland, in the shires of Ayr, Renfrew, Linlithgow, Fife, Edinburgh, and Haddington.

* Pogg. Ann. lix. p. 508.

In England, in the counties of Cumberland, York, Derby, Nottingham, Lancaster, Stafford, Chester, Flint, Leicester, Warwick, and Gloucester.

And in South Wales, in Monmouth, Glamorgan, and Pembroke, as well as in the two northern counties of England.

By examining a geological map, it will be seen that the northern coal-field is exceeded in superficial area, by the Irish field in the province of Munster; by the Scotch, which crosses the breadth of the island from Ayr, on the west, to Haddington, on the east coast; by the English in the Yorkshire and Derby field, extending through a great part of two counties; also by the Lancashire; and infinitely surpassed by that of Glamorganshire and Monmouthshire, in South Wales. The extent of area of—

South Staffordshire may be reckoned at	100	square miles
The Northumberland and Durham,	360	"
The Lancashire may be taken at between 500 and	600	"
The Yorkshire and Derbyshire nearly	700	"
And the South Wales,	1000	"

The north of England coal-field contains about 30 seams of coal—making a total thickness of about 30 feet.

The South Staffordshire contains only about 11 seams, but, to compensate, there is one 30 feet thick; whilst in the north, the average thickness of the best coal is under 6 feet.

The North Staffordshire possesses more than 30 seams—from a few inches to 10 feet in thickness.

The South Wales possesses about 100 seams—making 95 feet of coal, the thickest of which is 9 feet; the coal measures being about 12,000 feet.

The Lancashire has 75 well-defined deposits of coal—making about 150 feet total thickness.

The coal-field of the Clyde Valley has 84 separate seams, with a seam of 9 feet. thick; the entire thickness of these coal measures being reckoned at 5000 feet.

In Ireland the chief field worked is that of the Leinster; but, near Tyrone, an exceedingly fine deposit of bituminous coal has been found, from 20 to 30 feet thick.

One geologist, Conybeare, in his *Introduction to Geology*, states that the Yorkshire and Derbyshire Coal-field rivals, or surpasses, in importance that of the north, and which he conceives to be the re-emergence of the latter from beneath the magnesian limestone. Another geologist, Bakewell, in his *Geology*, calculates the South Welsh basin to be about 1000 square miles of 95 feet of coal, containing 100,000 tons per acre, or 64,000,000 tons per square mile—or almost as much as will supply the country at its present rate of consumption, for 3000 years. A matter of comfort for the present generation.

This sort of calculation, by Bakewell, of itself amounts to nothing, without taking into account other elements—as accessibility, facility of carriage, capital, and labor, and comparative qualities. For many years the difficult accessibility of some of the best Durham coal prevented its working—for want of the facility of carriage, now to be

removed, all the Midland coal has hitherto been kept out of the market—for want of capital and cheap labor in America, English coal can be delivered upon the finest coal deposits in the world, 3000 miles away, in the United States, at less cost than the coal beneath can be worked; and, by comparative quality, the finest coal of the Tyne having been much exhausted, the less worked coal of Durham, in the same field, brings 2s. per ton more in the London Market. The possession of a coal deposit, is not enough of itself, as these facts demonstrate.

Their Qualities.—The proportionate quantity of gas yielded by the Scotch cannel, the Gloucester cannel, the Lancashire and the Cumberland coal, and the constituents of these and other coals, demonstrate many of them to be equal, and, in some points, some of them superior, to the northern coal.

Mr. Accum, in his experiments at the Royal Mint Gas Works, procured from an equal quantity (one chaldron) of the following different specified coals, these results:—

	Cubic Feet of Gas.
Scotch cannel coal,	19,800
Lancashire cannel coal,	19,608
Gloucester coal, best,	16,584
Newcastle coal, best	16,920
Ditto another variety,	16,584

The Warwickshire coal continues to give out good gas longer than either the Newcastle or South Wales.

Their Constituent Principles.—The following are the general constituent principles of different varieties of British coal, as shown by Kirwan, Dr. Watson, Dr. Ure, Karsten, and others:—

	Volatile Matter.	Charcoal.	Earthy Matter.
Newcastle,	40·	58·	1·80
Whitehaven,	41·6	57·	1·7
Lancashire,	36·7	61·73	1·57
Derbyshire cannel,	47·	48·36	4·6
Scotch cannel,	56·57	39·43	4·
Leitrim,	23·37	71·43	5·20
Alfreton furnace coal,	45·60	52·45	2·04
Swansea,	23·94	73.53	3·3
Welsh furnace coal,	8·59	88·06	3·4
Welsh stone coal,	8·	89·70	2·3
Kilkenny,	0·	97·3	3·7
Anthracite,	0·	97·25	2·7

In this list we perceive a richer and more bituminous coal than in the Newcastle, in the Whitehaven, Scotch, and Derbyshire cannel, and Welsh coals. The too frequent explosions of fire damp amongst them give indications of their rich gaseous and bituminous composition; and in the Irish, Kilkenny, Welsh stone coal, anthracite, and Swansea, we find, for smelting of iron and steam purposes, a coal infinitely better adapted for these most useful objects than that of the northern field. The coals of the northern field, though, to a certain extent, uniform in each mine or locality, differ widely as to their nature and quality throughout the whole deposit—hence the value of

the produce varies at this moment in the London market from 11s. 9d. (Oakwellgate) to 17s. 3d. (Haswell); the average of the three lowest being 12s. 7d., and three highest 16s. 11d. per ton—a difference of upwards of 30 per cent. Whatever be the result to the superior description, the inferior quality, forming more than one-half of the coals shipped to London and the other coast markets, will the more easily meet with successful competition from the southern and western fields.

With regard to the anthracite description of coal, Lyell states, in his *Geology of North America*, "that, as managed by the Americans, I have no hesitation in preferring its use, in spite of the occasional steam-like heat produced by it, to that of bituminous coal in London, coupled with the penalty of being constantly in a dark atmosphere of smoke, which destroys our furniture, dress, and gardens—blackens our public buildings, and renders cleanliness impossible." The anthracite which he thus eulogises is similar to much of that of South Wales—it burns without smoke, leaving a clear atmosphere. Some of the American manufacturing cities having over them an atmosphere as pure as that of Naples. Notwithstanding all these advantages (and they are many), and the eminent opinion just quoted, we question much if this anthracite, with its difficulty of lighting, its sluggishness, and drying effects on the air of rooms, even with the assistance of the Arnott stove, will displace the best bituminous sea coal of the north, with its cheerfulness, light, and warmth. The smiling comfort of an English fireside consists materially of these qualities, and we hold with Professor Ansted, in his *Text Book*, that "the coal of the northern coal field is the most bituminous, and the best adapted for economical purposes of any yet known."

From the fortunate union and proportion of volatile matter and charcoal in the best description of northern coal, with its great freedom from earthy matter—its abundance and accessibility—it has, up to this period, enjoyed, not only at home, but in the markets of the world, a pre-eminence and demand beyond rivalry. These are the causes of its success, in our opinion, though, we must admit, it is not that which generally obtains throughout. We must not blink the fact, that practical men entertain the opinion that the more accessible position of the northern coal-field, intersected by three navigable rivers, has been the chief cause of this advantage; and that it will be reduced, if not altogether destroyed, by the at least equal facilities of carriage, soon to be afforded by the established and projected railways to the other valuable coal districts of the kingdom. It would not be safe, in an inquiry of this nature, to throw discredit upon that belief, or to abstain from weighing its consequences, because they may be of a serious and injurious nature—such a procedure would not prevent, but might facilitate, the dreaded results. A wise course in this, as in all difficulties or dangers, seems to be to look the evil firmly in the face, and calmly to investigate its nature and mode of approach; then, with a full knowledge of all the circumstances attending it, to decide clearly, and act with energy. It is safer thus to do than to affect to despise what you fear—to shut the eyes to it, and fancy it afar off, till it is upon you, and unpreparedly overwhelms you. That would be

to see the cloud that bears the hurricane, and to send all hands below, and not to furl the sails and prepare for its furious bursting.

We have seen then, that, in extent and abundance, the northern coal-field is infinitely surpassed by the deposits of the other districts, and that it is approached by many of them in quality, and in some instances exceeded, for particular purposes. These immense resources of British mineral wealth, it appears, only require favorable opportunities and means of transport for their development.

Their Geological Accessibility.—That it is not the geological accessibility of the northern coal that gives it its advantage, may be inferred, when it is stated, that the mines for this coal are the deepest and most expensive in the country, frequently overlaid with immense feeders of water and quicksands, as that of Haswell, discharging 1000 gals. a minute; or that of Datton-le-Dale, requiring pumping-engines to the amount of 1274 horses, to enable them to pass a quicksand. Some of these mines are 1200, 1300, and even 1700 feet deep,—as the Monkwearmouth, 1794 feet, costing upwards of 80,000*l*, whilst those of Derbyshire and Leicestershire seldom are more than 700 or 800, but occasionally 1200 and 1300—(near Chesterfield the pits are from 300 to 500 feet deep, from which coals are now being sent along the railways to London)—those of Staffordshire are generally only from 100 to 600 feet deep—the average being about 450 feet, the deposit frequently rising to the day; Lancashire, on an average, are from 750 to 100; and Wales generally much less, even than the Staffordshire, and are often worked level free—so that, on this point, the northern coal is placed at great disadvantage. It has thus been a combination of quality, geographical accessibility, and unusual facilities of transport, that has hitherto given a predominance to its demand.

Now, let us exactly see our present position. Nearly similar good qualities with the northern have been discovered in other British coals, more abundant, and, geographically, more accessible, but kept out of the market hitherto, except the local supplies, by their geographical and topographical position in the interior, removed from convenient shipping ports. This obstruction to their general competition, which has aided to produce the almost monopoly of the northern coal trade, and the consequent splendid commercial marine attached to it, is, however, it is calculated, about to be greatly reduced, if not entirely removed, by the facilities of conveyance of the numerous lines of railways, entering and intersecting all the British coal-fields, which will transport their produce to London—the great mart of the northern coal, and distribute it to all the various towns and districts of the country.

Distances of the several Coal-Fields from London.—The statement of the distances of the different coal-fields from London, in whose market—the seat of its strength—the northern coal will encounter its great competition, is all that remains, with the cost of transit on railways, to demonstrate our position:

The Warwickshire Coal-field is under	100 miles from London
The Staffordshire Coal-field is less than	125 " "

The Leicester Coal-field, at Leicester, is	122	miles	from London.
The Great Coal-field of Derbyshire and Yorkshire, at Derby	152	"	"
The South Wales Coal-field, at Merthyr Tydvil, is	135	"	"
The Lancashire Coal-field is about	190	"	"
The Great Northern Coal-field, at Newcastle, is	270	"	"

So that, in a competition of carriage of coal by land to London, the northern coal-field will be cut off by the nearer, and then the more fortunately-placed coal fields, which will enjoy the advantage by land that the northern does now by sea. A reflection deeply interesting to the northern coalowner as shipowner.

It is an interesting fact, that the various coal-fields of England and Scotland will, from each adjoining field, meet the next adjacent nearly on a radius of 30 miles, forming a chain of deposits from Scotland to South Wales. That, therefore, the whole country, from north to south, will be supplied with coals, nearly within their circumference, from their several points. The east and west coasts,to their very verge, not exceeding 50 miles at any point, from the nearest coal district. The south-east and south-west of England, and the north of Scotland, and north-west of Ireland, possessing the most distant points, yet those not extending over 150 miles, will show the easy practicability, by railway facilities, as existing on several of the combined goods and passenger lines, of supplying land-carried coals, exclusive of sea-borne, to the entire country.

If London then, not more than 100 miles from the nearest mines, can be supplied with railway-carried coals, it is evident that the country, at no point 50 miles from the mines, with immaterial exceptions, will be more certainly supplied by similar means. Min. Jour.

On the Manufacture of Glass. *By* Mr. Pellatt.

Though we have accounts of foreign glass having been used in this country during the seventh century, yet the manufacture of glass in England is comparatively of recent date; the first manufactory having been established at Savoy House, in the Strand, in 1557, probably by French Protestant refugees, most of the technical terms in glass making being from the French. In 1670, the second Duke of Buckingham advanced the manufacture by the introduction of Venetian workmen; and three years afterwards the first plate of glass was produced at the works of that nobleman at Lambeth. In 1773, a royal charter was granted to the Governor and Company of British Plate Glass Makers; their works are at Ravenshead, Lancashire, and are the most capacious in Europe. Since this period, the manufacture of glass, notwithstanding the restrictions to which it has been subjected, but which are now removed, has continued to advance. Before considering the manufacture of glass, it is necessary to say a few words respecting the mode of preparing the crucibles and furnaces for melting the materials. Every glass maker is his own potter and furnace builder. The preparation of the crucibles involves the greatest care,

because upon the quality of them depends all the after processes and results. The material used is fire-clay. The clay best suited is that which contains the most silica. The crucibles or pots are made by forming the clay into small rolls, which are spread, layer over layer; with considerable pressure: the whole is thus built up little by little, allowing the clay to harden, so that the shape is preserved. During the building and afterwards, the pots are in a room in which the temperature is regulated at about 60°, and all draughts excluded; five or six months are required in this temperature to dry them. The reason of so much care is to exclude as much air from the clay as possible; which, if it existed in quantity, would, upon the pot being brought into contact with the high temperature of the glass furnace, become so expanded as to burst; and also to insure a capacity in the pot to withstand the sudden contraction and expansion to which it is exposed. Pots are of two different constructions—closed and open; the former are used only for *flint* glass, the latter for all other descriptions in both shapes. The upper part is the most capacious: the reason for this is, that the heat reverberates from the top of the crown of the furnace directly upon the top of the pots. The pots cannot, of course, be exposed *cold* to the heat of the furnace, but have to undergo a gradual heating till they attain a white heat, and this is done in a furnace constructed for the purpose, from which all air is carefully excluded; from this furnace they are removed upon iron carriages to the glass furnace. The heat required to melt glass, especially that made without lead, is very great; yet, on account of the danger to the crucibles from any sudden rush of air, it is impossible to make use of blast, or even fanners: the proper draught is secured by the construction of an air funnel, called a cave, and by having the glass-house so constructed that it can be closed from the entrance of external air above. Upon the arch of the cave the furnace floor or seige (from the French *siège*, seat of the pots) is constructed, formed of strong heavy square bricks. The round furnace is used for flint glass, the flames finding vent by flues passing through the pillars of the furnace, having chimneys upon the outside for carrying off the smoke. Square furnaces, again, are employed for glasses without lead, a greater heat being required; which is obtained by the grate-room running the whole length of the seige. The proper construction of the furnace is of great importance to the operations of the glassmaker; in fact, good glass cannot be made without a good furnace. There are several distinct varieties of glass manufactured; and so different are they, both in preparation and manipulation, that they may be considered separate manufactures. There are, however, only two methods by which fluid or semi-fluid glass is formed to shape, viz. casting and blowing. Casting applies *exclusively* to *plate* glass, and is the emptying the glass out of the pot by casting it out upon a table, the casting of glass as metal is cast being yet unpractised: *blowing* applies to *all* other descriptions of glass.

The tools used by the glassmaker are simple: the blowing iron—simply a hollow tube; with this the semi-liquid glass is gathered from the pot and blown out into shape; the punty, for attaching to

the bottom of glass after blowing, so that the blowing iron may be detached, and the glass, being heated up, may be cut with scissors, and afterwards formed. The shears or procellos, for shaping the glass whilst it is turned by the workman upon the arms of his chair, or working bench. These, with the addition of a pair of scissors and pincers, are the whole of the tools.

All glass requires annealing, or cooling; the process is performed in a furnace called a lier, from the French *lier*,—figurative, perhaps, of the change in state, as well as atomic arrangement, which takes place during the cooling. We know that a change *does* take place, from the fact that glass before cooling is of greater bulk and less specific gravity then when cold; that it parts with a portion of *color* during the process, probably by giving off oxygen; and that though, whilst in a fluid state, glass is a good conductor of electricity, when cold it is a non-conductor. The object of annealing is, by a gradual diminution of the temperature, to allow of that arrangement of particles necessary to the body at a low temperature, and which particular arrangement alone enables the glass to support sudden changes. The base of all glass is silica: the most convenient form in which it is found is in fine sand; upon the due proportion of this substance in glass depends its compactness of body, brilliance, and capacity to withstand sudden changes. It often happens, either on account of want of sufficient heat in the furnace, or in order to save time in the melting or founding, that too small a proportion of silica is employed. Glass which has this fault may be known by its rapidly attracting moisture. The different kinds of glass made are known by the names of plate glass, German sheet or British plate, crown or window glass, bottle glass, and flint glass; there are others, but they are merely modifications of these, and need not be noticed. Plate glass is composed of sand, carbonate of soda and chalk, with small quantities of arsenic and manganese; the proportions vary at different works, but the general proportion is—Lynn sand, 400; carbonate of soda, 250; ground chalk, 35, by weight. The quality of the glass depends upon the quality of the alkali. Plate glass is melted in large open pots. The furnaces are square, containing sometimes 4, sometimes 6 pots each; when the glass is melted, which takes 22 hours, it is removed to another furnace, where the pots are smaller, of a cylindrical form. Here it is fined, which occupies from 4 to 6 hours, and when free from air bubbles and impurity the pot with the glass is removed bodily from the furnace by means of a crane, and hoisted to the end of the casting-table, upon which the glass is emptied; a large iron roller which works inside the flanches of the casting table is then made to pass over the melted glass, in order to flatten it out; it is then removed upon a wooden table on wheels to the annealing arch, which is now at a high temperature, and here it is excluded from the atmosphere until cold. The glass is rough and uneven, but it is afterwards cut flat by machinery, and then smoothed and polished; it is these processes which render plate glass so costly. Crown, or window glass is of much the same composition as plate glass, except that a cheaper description of alkali is used; the ordinary mixture is, 500 cwt. Lynn sand, 2 of ground chalk, and 1 cwt.

each of sulphate and carbonate of soda. The square furnace and the open pots are used, there being generally six pots on each furnace. It takes from 14 to 20 hours to melt this glass, and it then requires to stand 4 to 8 hours to allow it to become free from all air bubbles, and to cool sufficiently for working. Window glass is formed by blowing: upon the blowing iron is gathered, at three several times, (the fluidity of the glass never allowing fewer,) the weight of glass necessary to produce the table, and which weighs 11 lbs.; this is then blown out, leaving a solid lump at the furthest extremity from the blowing iron, for attaching the punty; this is called the bullion. The punty being fixed to the bullion, the blowing iron is relieved by merely touching the glass with a wet iron; being firmly attached to the punty, it is removed to a small cylindrical furnace, called a flashing furnace, where a rotary motion being given to it, increasing as the glass becomes softened by the heat, the centrifugal force, together with a little sleight of hand on the part of the workman, produces a flat circular plate or table, as it is then called.

British plate, or German sheet, glass is of the same composition as plate glass, but the manipulation is different. The glass is blown into open cylinders, and, when cold, these are cut open along the length with a diamond, and placed in a flatting furnace, which is at a sufficient heat to bring the glass into a semi-fluid state, so that it falls quite flat. The sheets thus made are afterwards cut flat and polished. The size of the sheet is restricted to what can be blown and worked by one man; it is cheaper than plate glass, because all waste is avoided, and less cutting is required. Bottle glass is composed of the cheapest materials which can be procured—ordinary pit sand, refuse alkaline waste from soap works, refuse lime from gas works, &c. The proportions of the materials vary according to quality. Bottles are blown in moulds: the glass having been blown in the mould, nothing remains but to form the mouth; this is done, the bottom being attached to an iron punty, by holding the extreme edge of the neck to the heat for a short period, and, having collected a small quantity of liquid glass upon the end of a small iron, called a ring iron, a ring of glass is allowed to cover this extreme end, and this is afterwards worked into shape by a machine which forms the inside and outside of the mouth at the same time, merely by the workman turning the bottle on the iron upon his knee once or twice. The rapidity with which bottles are made is almost incredible; a workman, with the assistance of a gatherer and blower, will begin and finish 120 dozen of quart bottles in 10 hours, which averages nearly $2\frac{1}{4}$ per minute, and this is ordinarily done; and in some works the men are restricted to 2 per minute, to prevent the work being slighted. It may not be uninteresting to observe the low price at which this description of glass can be produced, now that the duty has been removed: quart bottles can be produced at the works at about 14s. per gross; each gross weighs 2 cwt., which is equal to 7s. per cwt., or 7*l.* per ton for manufactured bottles; if from this we deduct, for workmen and incidental expenses, 2*l.* per ton, it would leave the price of bottle glass 5*l.* per ton.

Flint glass is thus designated from calcined flints having been for-

merly used in its composition; this is now replaced by fine sand. The term flint glass is now applied to all glass into the mixture of which lead enters, and is used in the manufacture of table glass, &c. In the manufacture of flint glass the circular furnace is used, the pots surrounding the grate-room; on either side of the pots are flue-holes, which pass through the pillars, the smoke being carried up by flues outside these. The heat thus reverberates from the crown of the furnace, and is drawn round the pots previous to passing through the flue-holes. The melting pots are covered in, to protect the glass from dust, which would affect the color. The materials used in flint glass are sand, red lead and litharge, carbonate and nitrate of potash, arsenic and manganese; and the greatest care is taken in the selection of them, the beauty of the glass, depending mainly upon the quality of the materials. The best sand comes from Alum Bay, Isle of Wight; this is carefully washed and dried previous to using. Red lead, or litharge: this assists as a flux, and gives density, brilliancy and ductility,—the latter quality being particularly required in flint glass; it is, perhaps, owing to the superior quality of the oxides of lead prepared in England that we are in advance of other nations in the manufacture of fine flint glass. The carbonate and nitrate of potash are used wholly as fluxes; soda, though more active, is never used where quality is required, as it affects the color. For almost every purpose, the best glass of every description is that which contains the greatest amount of silica. If the sand, lead and alkali, even though the quality were never so pure, were melted, the glass which would be produced would not be colorless, but of a pale green; and this, in all probability, is not so much the result of impurity, as the deoxidizing effect of the fusion. To obviate this, it is necessary to use the oxide of manganese, which, by supplying oxygen, retains the different substances in that state of oxygenation necessary to a colorless glass; if too much manganese be used the color is slightly purple, designated by the glass makers "high;" the green tint, again, is called "low:" in other words, the glass is high when it contains more than sufficient oxygen, and low when too little. Minute quantities only are necessary; from a quarter to half an ounce per cwt. is sufficient. Arsenious acid is sometimes used in flint glass, its use being to expel the carbonic acid gas present in the materials; if too much is used it gives opacity.

Glass must be considered, unfortunately for science, an imperfect body. The principal imperfection, more especially of flint glass, arises from what are called cords or striæ in the body of the glass, which give it the appearance of alcohol and water imperfectly mixed; through these striæ the rays of light will not pass, but are diverged and broken. This defect is attributed to the difference in specific gravity, or want of homogeneity of the particles; this, no doubt, is true; but the question is, to what cause is this attributable? I would suggest, that it may arise from the unequal distribution of heat to the materials during fusion and whilst in a fluxed state, and to the particular action consequent thereupon. The number and variety of articles manufactured in flint glass are great, and require considerable practical experience on the part of the workmen. It is impossible to describe the manner of operating, which appears even to

those who have often seen it almost magical. It is certainly surprising to see an apparently opaque and fluid body in a moment become transparent and solid, and, whilst undergoing this rapid change, to see it take beauty of form. The substances used for producing colored glass, are the metallic oxides, the quantity being proportioned to the depth of color we desire to obtain. For blue glass we use oxide of cobalt; this produces a rich color: the material, however, being expensive, it is seldom used by the glassmaker alone, but generally with an equal quantity of manganese: this materially affects the richness of the color. Green is obtained from the oxides of copper and iron, mixed, the protoxide of copper and the peroxide of iron: equal quantities may be used, the proportions being varied according to the tint desired to be obtained: the copper produces a blue-tinted green, and the iron the yellow tint. Purple is obtained from the oxide of manganese; the purer this substance is, the finer will be the color. The pyrolucite already referred to, especially when used in small quantities, gives a beautiful and delicate amethyst color. Ordinary yellow is got from carburate of iron and oxide of manganese. Ruby is obtained from the oxide of gold, called the cassius precipitate; it is a color which is neither obtained nor retained with any certainty—in fact, the modern glassmaker is quite at a loss for this color. There can be no doubt the ancients manufactured ruby of a much finer color than any now made, from sub-oxide of copper; this art has been lost for centuries: the difficulty is, the preventing this substance from peroxidizing. The oxides of uranium produce beautiful tints in yellow and green. Copper scales give azure blue; oxide of chromium, emerald green. Opaque glass is produced by the addition of phosphate of lime, arsenic, and other substances. The addition of many of the metallic oxides renders glass less ductile; and in making use of these it is always well to employ an additional quantity of lead. We often hear of the superiority of the color of ancient sheet glass to the modern, and are bound to conclude, when we see, particularly in church windows, the difference, that there is good ground for the assertion. With the exception of ruby, the modern colors are all finer than the antique. I speak of body colors—that is, glass made of colored mixtures, called pot metal; but this is seldom used, all our modern church windows being made of white glass stained with metallic colors; this saves trouble and expense in the fitting. Glass of various colors in the same piece is obtained by casing one metal or glass with another. A small quantity of one color having been gathered, it is blown into a small ball, and dipped into a pot of a different color; this being rolled on an iron slab, so that an equal thickness of the second covers the first, the ball is a trifle enlarged by blowing, and may be dipped into a third and fourth color. Care must be taken that the character of these different glasses exactly agree, that the contraction in cooling may be alike.—*Trans. Roy. In.* Athenæum.

Painting on Glass.

There are three kinds of painting on glass; painting with the different colors on separate pieces of glass, painting on uncolored glass, and

painting on crystal. The first two methods are frequently combined so as to constitute a fourth kind of painting on glass. The first kind of painting is incontestably the most ancient. Glass is prepared in sheets, blue, violet, yellow, green, and red, and after being divided into pieces of the proper size and shape, the separate portions are put together by glaziers' lead.

The preparation of purple glass has fallen into such disuse, that till very recently, the art was considered to be entirely lost, but this is not the case, for there still exist printed receipts which describe all the details of the operation. Baptiste Porta, who was born in the year 1540, has given one of the receipts in his *Magie Naturelle*, and he has taken care at the same time to warn us of the difficulty of obtaining a successful result. Other receipts are found in the compilations of Néri, Merret, and Kunckel, and have been transferred to the encyclopædia. No information, however, is given respecting red glass. It is not prepared with the purple of gold, for this substance gives neither a scarlet red nor the red of clear wine: instead of oxide of iron, the protoxide of copper is used. But as this last produces an exceedingly deep color which deprives the glass of its transparency, the usual plan is to cover white glass with a thin layer of red glass, so as to form a kind of plated glass. The process is as follows:—there are placed in the furnace two crucibles, of which one contains common glass, the other glass of the same composition, but colored with protoxide of copper, to which is added protoxide of tin. This last body tends to prevent the oxidation of the protoxide of copper which would have the effect of coloring the glass green. A small addition of protoxide of iron gives a scarlet red or flame color. If the glass take a greenish tint, a little bi-tartrate of potash will renew the colors by restoring the bi-oxide of copper to the state of a protoxide. The workman commences by taking on his "blowing-iron" a small quantity of red glass; he then plunges the tube into the white glass, of which he takes a much larger quantity, and he then blows it out according to the ordinary method of making "tables" of crown glass. This method was employed for the ancient glass of church windows; at the present day this glass is manufactured at Hoffmungsthal, in Silesia, by the Tyne Company in England, by Bontemps in France, and at Besançon.

The glass, as has been said, is cut up into colored plates. The tints and half tints are applied by means of colored enamels on one face or the other of the glass, which is exposed to heat, and the different pieces are joined by glaziers' lead according to the pattern or design. If the paintings be small, and designed to be viewed close, plated glass, and not glass colored throughout its thickness, is employed. Parts of the colored layer are removed at the requisite places, and on the white glass thus laid bare, the colors required for the painting are applied. In this way designs are obtained of which the colors differ altogether from the ground color. Instead of removing the colored layer by mechanical means, it may be destroyed by fluoric acid.

The effect of the weather insensibly alters the colors of ancient paintings on glass.

Painting on glass properly so called, that is to say, the application of colored enamels to uncolored sheets of glass was little known to the ancient artists, and it is only in our own day that the progress of chemistry has advanced this art to any degree of perfection.

Painting on uncolored glass was executed in 1800 by Dihl; it consists in tracing the same design on two sheets of plain glass, which are submitted to the action of fire, and then the faces on which the designs are drawn are laid one upon the other.

To fix by heat the colors on glass without altering its form, or fusing it, it is necessary to add vitreous matters, which are readily fusible, fluxes, which vary according to the nature of the colors.

Silicate of lead is employed with or without borax, minium and very fine sand are fused together, and different proportions of calcined silex and quartz. For instance, take

Quartz	3 parts	or	Borax calcined	5 parts.
Minium	9 "		Quartz	3 "
Borax calcined	$1\frac{1}{2}$ "		Minium	1 "

The quantity of flux required for each color, so that it may have the required fusibility and clearness is very variable, the necessary proportion is in general three or four parts. All colors are not adapted for the same flux; the purple of gold, the blue of cobalt, require an alkaline flux; the minium injures these substances, while other deep colors are not injured by fluxes into which lead enters.

Some substances require to be vitrified with the flux proper to them, before they can be employed in painting, as the feeble heat to which they are subsequently subject is not sufficient to develop the color properly. The deutoxide of copper, and the yellows, blues and violets, are among these substances. With purple of gold and oxide of iron, on the contrary, great precautions are necessary to prevent the injury of the color by too great heat. The colored enamels when prepared are reduced to powder; and preserved from the action of moisture.

All kinds of glass are not suitable for painting. Excess of Alkali is destructive; preference is therefore given to the hardest glass, which contains a great deal of silex, and which does not attract moisture, as the Bohemian glass for instance.

Before applying the colors with the brush, they are mixed on a palette with turpentine. When the painting is finished the colors are fixed by heat, an operation which requires great care and experience. Pots of fire-clay closed by a cover of the same substance are placed in a support of iron, so that they can be enveloped on all sides by the flames; the method adopted in France for cooling glass is to put it in separate furnaces heated by charcoal. The plates of glass are laid one upon another on clay slabs, supported on props of the same material. The heat is judged of by trial-pieces, which are introduced with the rest of the glass into the furnace, and are withdrawn with a spatula. When the colors are well vitrified, the plates are put in the annealing oven and gradually cooled. It is necessary that this last operation should be conducted very gradually, to insure the permanence of the colors.

The color communicated to glass by the protoxide of copper is, as has been observed, too intense to be employed alone, for it causes the "metal" to appear opaque of a deep brown. It is necessary, for procuring a transparent red, that the glass should be extremely thin. Consequently, the only means of getting red glass of a proper thickness is by covering plain glass by a thin layer of red. The plated glass has the advantage of allowing the partial removal of the red layer, in order to obtain white figures, or add other colors. The glass of the Middle Ages shows that this method was adopted by the ancients.

In order, that, when the red and white glass are blown together, they may be well united, and do not separate during cooling, (as happened in some of Engelhardt's first experiments,) the "metal" of both must be the same, or at least analogous. It is best to make the red a little weaker than the white; the latter must not contain any oxydizing substance, which would injure the red color.

Great care is required to avoid air bubbles in the glass. The red and white must be ready at the same time, in order to work together well. The beauty of the glass depends also materially on the skill of the workman, for it is easy to understand that the colored glass is always thicker near the orifice of the blowing-iron than at a distance. It is on this account that the glass is seldom of a uniform color, except in the middle of the plate: at the extremity of it the red layer is sometimes so thin that all trace of color is lost. Dr. Engelhardt has preserved several ancient specimens, in which this gradation from a deep color to a light one, has been made use of in a very happy manner to produce striking effects. After a certain degree of practice, the workman is able to obtain a tolerably uniform color, and Dr. Engelhardt expects to effect this object completely in a glass manufactory where he has directed attention to this particular branch of the art.

It is sometimes necessary, when the glass has once been painted and the colors fixed by baking, to add a second coat of painting; and as it is then necessary that the glass should be again subjected to heat, the coloring matter must be rendered so fusible by an additional proportion of flux as to avoid all risk of fusing the colors first painted.—*Translated from the Revue Scientifique et Industrielle.*

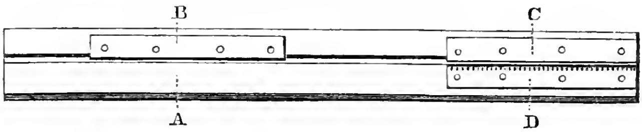
Civ. Eng. & Arc. Jour.

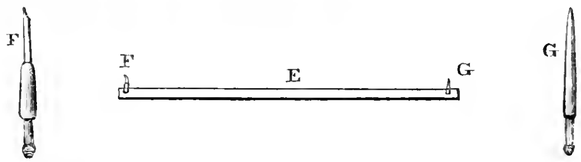
On a convenient Instrument for Graduating Glass Tubes. By Dr. Playfair.

Dr. Playfair described an instrument for graduating tubes, invented by Professor Bunsen, of Marburg, and used in the researches on the gases from iron furnaces, and in the late experiments read to the Society on specific gravity. It consists of a mahogany board $5\frac{1}{2}$ feet long, 7 inches wide, three-quarters of an inch thick. Throughout its centre is a groove 1 inch wide, half an inch deep, arched at bottom, for the reception of tubes. At one part, five inches from the end, i placed a brass plate, $1\frac{1}{5}$ foot long and 2 inches wide, in such a posis tion, that when screwed down, its edge comes one-half over the groove-

It is furnished with 4 screw-nuts, passing through a cut portion of the plate, a quarter of an inch long, so as to allow a certain advancement or withdrawal of the plate at pleasure. C and D are two similar plates, (one foot 9 inches long,) placed at the other end of the wooden board, C having the same amount of motion as B, and being precisely similar in every respect. D is a brass plate of the same dimensions as B and C, but the screws go through a hole of the same size as themselves into the wood. It is cut, at intervals of five millimetres, into notches, every alternate one being one-twentieth and one-tenth of an inch deep. The instrument is provided with a wooden rod, 3 feet long, 1 inch broad, and half an inch thick, E. This is provided with two steel points, placed by screws at half an inch from either end. One of these, F, is in the form of a knife, the other, G, of a brad-awl. The instrument is furnished with a screw-driver, that these may be removed at pleasure.

Scale six tenths of an inch to the foot.





F and G are half size.

When a tube is to be graduated, it is covered with a thin layer of melted wax and turpentine, by means of a camel's-hair pencil, and is placed in the groove between C and D, which are then screwed down in their places, so as to retain the tube firmly in its position. A standard tube, previously mathematically divided into millimetres, (the most convenient division,) is now placed in the groove under B, which is then screwed upon it. The rod E is now used, the pointed steel G being put in one of the millimetre marks on the standard tube; the knife-formed steel, F, is now upon the waxed tube, and is made to make a mark upon it, the length of which is regulated by the distance between the edges of C and D. The pointed steel is now removed back one millimetre on the standard tube, and the corresponding mark made on the waxed one; and thus we proceed until the whole of the waxed tube is divided into millimetres. The object of the notches is, that a longer mark may be made at every five millimetres, and a still longer one at every ten, in order to aid the eye in reading. The waxed tube is now removed to a leaden chest, containing pounded fluor spar and sulphuric acid, slightly heated, which etches it more successfully than a solution of hydrofluoric acid. Previously, however, to being etched, it is desirable to figure the number of millime-

tres at the space of every ten; and this is conveniently done by the steel pointer G, after being removed from E.

We have thus an accurate measure of length etched upon the tube, which should have been one of pretty uniform calibre. The next point is to determine the true value of each of the divisional marks. This is done by calibrating it throughout all its length with small portions of mercury, say equal in bulk to five grains of water. By this means, the relative value of each mark may be determined, and the proportion which it bears to any given standard. The only possible error is in the assumption that the tube is of even calibre between the space occupied by the mercury; but the quantity of this added is so small that any such error becomes quite inappreciable.

The convenience of this graduator is so great, that a long tube may be beautifully divided in the course of a quarter or half an hour. The standard tubes should be made of glass, but the original divisions from which this standard is made may be made on wood or any other material.

Proceed. Chem. Soc.

On some Products of Chinese Manufacture collected by M. Jules Itier, Chief Inspector of Customs.

I. *On two kinds of textile plants, from which fine Canton lawn, or cambric, called in England grass-cloth, and coarse fabrics are produced.*—Several varieties of fabrics are to be met with in the Chinese market, differing very much from any European manufacture, particularly in respect of their stiffness and consequent coolness, on account of which they are much preferred by the Chinese to European manufactures. Amongst the number of these fabrics, which are manufactured at Quang Tong, where they are known by the generic appellation of *ha-pou,* (in Mandarin *cha-pou,*) are those known in France by the name of *Canton cambric,* and in England *grass-cloth,* and called by the inhabitants of Canton *yun-chest-yaô-ha-pou,* when in a raw or unbleached state, and *piou-pa-yaô-ha-pou,* when bleached; which, being literally translated, means *fine unbleached summer fabric,* or *fine light bleached summer fabric.* Besides this kind of cambric, of which there are infinite varieties as regards fineness of texture and consequent value, other fabrics of a coarser texture are manufactured, called *tso-ha-pou,* which means, literally, *coarse summer fabrics.*

The substance from which these various fabrics are made, is obtained from the bark of two kinds of textile plants, cultivated on a large scale, at a distance of 30 or 40 leagues N. E. from Canton, in the district of Si-Nam, and particularly at the small town of Hoang-Tchiang; they are known in the country by the name of *lo-ma,* (cannabis indica?) and *tsing-ma,* (corchorus?)

From the first, *lo-ma,* which is also cultivated in the environs of Canton and Macao, coarse fabrics are produced; from the second, *tsing-ma,* fine fabrics, or cambrics, are manufactured. Some fabrics are made by employing the *lo-ma* for the weft, and the *tsing-ma* for the warp.

The following is the method of cultivating the *lo-ma*:—After having manured the ground, it is well broken up, and in the rainy season, at the commencement of spring, the grain is sown very sparingly, and near the surface. The ground is then covered with a thick layer of straw, or dried herbs; and if it is a dry season, the ground is watered in such a manner that the water, dripping through the straw, &c., may act gently upon the earth, without any danger of washing away the seed. When the plant appears above ground, the straw, &c., is removed; and after being suffered to grow a little longer, the plants are thinned, so as to leave them standing at a distance of five inches apart. In about eight months, the plants will have attained maturity, and as they are of the class *diœcia*, they are treated in the same manner as hemp, *i. e.*, the male plants are first removed, after fecundation, and a fortnight or three weeks afterwards the female plants are gathered. The plant grows to a height of five or six yards, and is about two-thirds of an inch in diameter at its base.

In order to extract the thread, the plant is cut round outside near the root, and the outside, thus cut, is easily stripped off. It is then soaked in water for two days, and afterwards dried in the sun, and separated by hand into long threads, which are prepared for use in a manner similar to hemp.

Tsing-ma is cultivated in the same manner as the *lo-ma*, but it does not require so high a temperature. In order to prepare the thread, the plant is to be tied up, while green, into bundles of from three to four feet in height, and about eighteen inches in thickness, and placed upright over a large shallow iron vessel filled with water, the edges of which are raised by means of a lattice-work of bamboo, covered with clay. The furnace is then lighted and the water heated to the boiling point for several hours, until the plant is completely cooked by the steam; it is afterwards well dried in the sun, and soaked in cold water, and by dividing it near the root, the bark or covering may be easily stripped off. It is then split and divided into very fine threads, by means of combs, &c. The thread is made without any twisting, by simply joining the ends of threads of equal dimensions.

It is probable that these two qualities of hemp might be cultivated very well in Algiers, more especially in the plain of Mitidja, and also in the south of France. The naturalization of this plant would be the more desirable, as a well-known English manufacturer, Mr. Hargrave, announced in the *London Mail* of 24th June, 1845, that he had made a great many experiments on spinning *tsing-ma* thread by machinery, and the result was very satisfactory, as the thread produced was much finer and stronger than that obtained from any European plants, and that he was then manufacturing from it, fabrics as fine as French cambric.

In the spring of this year, M. Itier caused these two plants to be sown at Montpelier, Perpignan, Grenoble, Lyons, and Paris; and it is to be regretted that the Government has not caused any to be sown in Algiers.

II. *On the manufacture of thread, or yarn, and fabrics, from abaca, nipis, and pina, indigenous to Manilla.* Abaca or Manilla

hemp is the produce of a banana tree, indigenous to the Phillippine islands, and known to botanists by the name of *musa troglodytarum*. It is cultivated, on a large scale, in the provinces of Camarines Norte, Camarines Sur, Albay, (Island of Luçon,) Samar, and Leyte,—islands bearing those names.

For this purpose the sides of mountains, newly cultivated, are preferred. The young plants, after having their tops cut off, are placed at a distance of fourteen feet apart, in holes about six inches square. During the first two years this plantation only requires weeding twice a year, in order to destroy the noxious weeds, which would soon kill the plants; in the course of the third year the largest stalks are cut. As the banana tree possesses the property of continually putting forth fresh shoots, the plantations will last for any length of time.

In order to prepare the *abaca*, the banana top is split into several long strips, which are passed between a thick plank placed in a horizontal position, and a metal blade pressed forcibly upon it; the strip is drawn through, and in this manner scraped, and the fibres deprived of the pulpy integuments; they are afterwards dried in the sun, and are easily separated; it then only remains to sort them and tie them together.

It is calculated that a foot of banana will furnish from ten to twelve ounces of thread, and that one workman can prepare 50 lbs. of abaca *per diem*.

Before the year 1823, the production of abaca was of very little importance; not more than 200 lbs. per annum were exported. The quantity exported now is upwards of 2000 tons. Ropes, cordage, and various fabrics, are made with abaca. There is a rope manufactory at Manilla, worked by steam, which furnishes a large quantity of ropes, &c., for maritime purposes. Cordage made from this substance does not shrink from damp; but this advantage is counter-balanced by several disadvantages, in consequence of which the abaca cordage is much inferior to that manufactured from hemp; for instance, the former is never so flexible nor so strong as the latter.

The abaca fabrics are a kind of transparent cloth, somewhat stiff, light, and very cool to the touch, from which the *Tagals* make colored shirts. These fabrics are generally striped, and often printed; they might be used with advantage for sifting and straining purposes. Abaca thread does not require to be spun; it is used as produced by nature, and simply joined together end to end. The threads are tied together in bundles, and beaten, for the purpose of softening them, and afterwards bleached by immersion, during twenty-four hours, in lime-water, and dried in the sun; they are then in a fit state for weaving.

A fabric, known under the name of *medriniac*, is also manufactured from unbleached abaca thread, which may be advantageously used for linings of clothes, &c.: this fabric is extensively used for these purposes in Spain.

From the finest abaca thread a pretty stuff, called *jusi*, (houssi,) striped with various colored silks, is manufactured. It is sold at the rate of two piastres every twenty tares, or about six-pence per yard.

Pina is a thread obtained from the leaf of the ananas or pine-apple; it is prepared in the same manner as abaca thread, great care being observed in picking or sorting before uniting them. This thread may be dyed.

Nipis, or vegetable silk, is a filament produced from the leaf of the *nipis* palm tree. A species of pina, of inferior quality, is made from this fibre.

The stuff known at Manilla by the name of *sinamaye* is manufactured from pina and silk, forming stripes of various sizes and colors. Ladies dresses are made from it, and also fine shirts and stomachers.

III. *On the Manufacture of enamelled copper, at Canton.*—When the copper has been shaped into the desired form, it is to be cleaned, but not scoured, and afterwards wetted with water, and sprinkled with the enamelling composition intended to form the ground, which may be either white or colored: the article is then put into a muffle heated by means of dry Nankin coal (this is found to be the best fuel.) When the ground has been produced, the article is withdrawn from the muffle and covered with an iron bell, in order that it may cool slowly: the ground may be then ornamented in the same manner as porcelain, and again passed through the muffle.

Several specimens of enamel, and colors upon enamel, have been deposited by me at the royal manufactory at Sevres, in order that the manufacturers in this kingdom may be made acquainted with the art.

IV. *Method of preserving eggs in China.*—It is customary in China to salt eggs, and by this means to preserve them for several years; the method of doing this is very simple:—A saturated solution of sea-salt is made, and the eggs are placed therein and suffered to remain until they sink to the bottom; they will then be sufficiently impregnated with salt, and may be taken out, left to dry, and packed in cases. These eggs, which are generally eaten boiled hard, are excellent, and they will be found to be salted to the degree most agreeable to the palate.—*Translated from the "Bulletin de la Société d' Encourag.*

Lon. Jour. Arts & Sci.

Production of Coal in the Different States of Europe.

After iron, there is certainly no produce in the mineral kingdom which exercises a greater influence on our commercial relations than coal.

The following is a statistical sketch of the produce of that article in the different countries of Europe.

England possesses the richest veins of coal, both as regards quality and quantity; they form a line from south-west to north-east. In Northumberland and Durham, from the Tweed to the Tees, coal abounds; at Whitehaven, in the hills of Cumberland, in Yorkshire, and in Lancashire. The most abundant mines are in Wales.

The consumption of coal in England and in exportation, is so great, that it has often been asked, if the mines would not be exhausted; but, according to calculations made in proportion to the present con-

sumption, they could not be exhausted under 1500 years—the yearly consumption in Great Britain is 20,000,000 to 21,000,000 of tons.

The exportation increased in the following proportions:—In 1830, 505,421 tons; in 1832, 588,450 tons; in 1834, 621,256 tons; in 1836, 1,101,000 tons; in 1838, 1,413,800 tons; in 1840, 1,621,300 tons; in 1842, 2,120,000 tons; and in 1844, 2,410,000 tons.

The number of miners exceeds 500,000.

English coal is to be had in every part of the civilized world; there are deposits at Rio Janeiro, at Odessa, at Archangel, and at Constantinople.

France does not produce enough coal for her own consumption, and is obliged to import. She possesses 250 mines, of which 182 are worked, and which rendered in 1844, 72,000,000 cwts. of coal to the value of 21,000,000 fr. (£840,000.) The produce is increasing, as in 1815 they only rendered 17,000,000 cwts.; 40,000 men are employed in the mines, and traffic belonging to them. In 1842, the importation of coal into France, amounted to 16,718,328 cwts.

France imports her coal from Belgium, England, and the Prussian provinces on the Rhine.

Spain draws but slight profit from her abundant mines; the principal mine is in the Sierra Morena, the produce is not known. They import but little. In some of the principal Spanish ports, there are depots of English coal for the steamers.

In Portugal there are depots at Figuieres, at Coimbra, and near Oporto.

The principal mines of Italy, which produce annually from 140 to 150,000 cwts. are in the Savoy, and near Genoa. The others, scattered over the Peninsula, are of little value, and there are depots of English coal in the principal ports.

Belgium possesses immense mineral riches; in this country production increases. In 1831 the produce amounted to 42,800,000 cwts., and in 1844 it reached 84,232,420. In 1844 the exportation amounted to 1,050,000 tons, a value of about 6,000,000 florins (£600,000.)

Holland has no coal mines. There is a single mine in the country of Limberg. They import all their coal from England, Belgium, and the Prussian provinces.

Switzerland, though rich in metals, has very little coal, and imports a quantity from England. The only mine of any value in this country is at Hochefeld; in 1843, it produced 514,969 cwts.

Norway has no coal mines. In Russia the production of coal does not exceed 800,000 pounds. It seems that between the Don and the Dnieper, and in Siberia, there are rich coal mines, and the Government are now taking measures to turn them to account.

Denmark has one insignificant mine at Bornholm, and imports nearly all her coal from England.

Austria is rich in coal mines, but the produce is not in proportion with the number of her mines. The annual produce of coal in Austria is at least 12,000,000 cwts,: in 1843 it did not exceed 9,000,000. Of this amount Bohemia produces about one-half, Moravia, 2,000,000; Austria, 1,300,000; Styria, 1,000,000; Carinthia and the districts

of Ogragno, a little more than 500,000; Hungary, 600,000; the coast lands (Kusten-land), 60,000; Galicia, 3,000; Lombardy, a very small quantity.

Coal mines exist in nearly every province of the monarchy. In Bohemia there are veins of this mineral along the river Beraun, in the north of the districts of Klattan, Pisen, and Rakovitz, to the neighborhood of Prague. There are coal mines in the Erzgebirge, in the valleys of the Eger and the Biela, and at the foot of the Riesengeberg, from Schatzlar to Landskron.

The principal mines of Moravia are in the district of Brunr, near Rossitz and Oflovan, and the coal near the mouth of the Oder is of a superior quality. In the Archduchy there are mines near Wiener, Neustadt, Klingenfurt, Gübach, and Gloggnitz; in Styria, near Leoben, and Fohnsdorf; in Carinthia, in the valley of the Lavan, and in the neighborhood of Prevali; in Dalmatia; in Lombardy, in the districts of Como and Pavia; in Tyrol, near Haring, and in Hungary, in the Carpathian Mountains.

In 1844, Austria exported 773,065 cwts., of which 703,262 cwts. were sent from Bohemia by the Elbe to Saxony, 25,433 cwts. to Turkey, 23,210 cwts. to southern Germany, and 20,542 cwts. to Prussia.

Prussia possesses 540 coal mines, giving employment to 25,000 workmen. The produce in 1844 amounted to 53,000,000 cwts., or a value of 4,500,000 dollars (£675,000.) In 1841, Prussia imported 3,864,944 cwts. principally from England. Her exportation was 6,903,473 to Holland, France, and Poland.

In Bavaria, the produce is not what it might be; there are 40 extensive coal mines, principally in her Rhenish provinces, the produce is about 1,200,000 cwts.

In Saxony, the mines are worked with zeal, the produce amounts to about 4,000,000 cwts.

There are extensive mines near the forest of Thüringen.

The Grand Duchy of Baden possesses some valuable coal mines.

In the Duchy of Brunswick there is scarcely a mine.

In the kingdom of Hanover there are coal mines which occupy more than 1,000 workmen.

Wurtemberg is poor in this respect. The Grand Duchy of Hesse, the Duchy of Nassau, the Grand Duchies of Meckleburg and Olemburg do not possess coal mines. In the Electorate of Hesse there are some valuable mines, producing annually about 900,000 cwts.

Generally speaking, the production of coal in Europe is susceptible of being greatly developed, especially in some parts of the Austrian dominions. It is true, that during the last few years, much has been done, but there is still much more to do.

The produce of coal in Europe amounts annually, on a rough calculation, to 120,000,000 fl., or £12,000,000. Min.Jour.

Improvement in Smiths' Water Tue-Irons. By W. Noton.

The smiths' water tue-iron as fitted up on the ordinary construction, is bad in principle, lasts a very short time before it is destroyed,

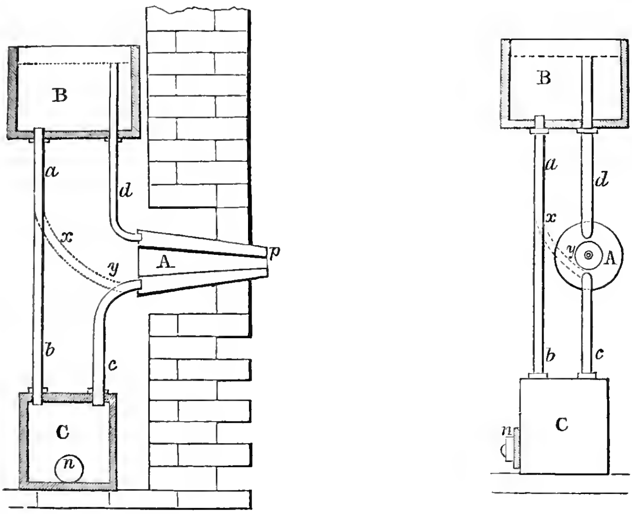
and is eminently calculated for being an expensive item in the economy of the smith's workshop. Much inconvenience and hindrance results from the frequent stoppage occasioned by the failure of this useful appendage to the smithy fire.

My attention was directed to the circumstance, eight or nine years ago, with the intention of finding a remedy for, or at least an amelioration of the evil.

Upon examination of the disabled tue-iron I found the inside, more especially the end nearest the fire, generally filled up with a substance sufficiently solid to prevent any water getting to that part; the place where it is most required to carry away undue temperature; thus the tue-iron is not fairly worn, but burnt out before its time.

What is meant by the ordinary construction may be understood by reference to figs. 1 and 2 of the prefixed sketch:—

Fig. 1. Fig. 2.



A, Water tue-iron.

B, Cistern for water, at a convenient height above A.

a x y, Wrought iron pipe, connecting the lower part of the cistern, B, with the lower part of the tue-iron, A.

d, Another pipe, connected with the upper part of A, and passing either through the bottom of the cistern, B, or by one side, and over the top with a bend.

Water poured into B will descend by the pipe, *a x y*, into the tue-iron, A, driving the air before it up the pipe, *d*, and if sufficient water be supplied till it stands at the height shown by the line in the cistern, the whole of the pipes and tue-iron will be full of water.

In actual working, the nose, P, is covered with burning coal; the water soon attains a boiling temperature, and steam being formed, a portion of the water is driven out of the tue-iron up the pipe, *d*, into

the cistern, B; when a fresh supply descends by *a x y*, to be in its turn heated and driven out as before.

If distilled water could always be supplied to the cistern, B, and that kept clean, the tue-iron would have a fair chance of doing its duty to the end; but as it is not so, and as there is a great probability that other substances get into the cistern, and ultimately find a settlement in the tue-iron, some contrivance was desirable for preventing the accidental, or perhaps, in some instances, wilful choking of the tue-iron.

The means adopted for this purpose will be readily understood by again referring to the two figures.

Instead of the water descending by the curved pipe, *a x y*, it is conveyed by the straight pipe, *a b*, into the cast-iron box, C, which is fixed considerably below the tue-iron, and must first be filled before any can rise up the pipe, *c*, into the tue-iron.

Should any sand or ashes get into the cistern, B, it will settle in the box, C, and not in the tue-iron, which will be supplied with water containing no heavy particles.

Amud-hole door, *n*, is provided by which the box may be cleaned out at any time when the work is not going on.

This additional apparatus, if attended to, will ensure a satisfactory working and add a considerable period to the existence of the water tue-iron.

The box, C, I have made, is of the capacity of one cubic foot to each fire, and I would recommend that the mud-hole door be opened every two or three weeks according to circumstances.

On the Coal Fields of Alabama. *By* Charles Lyell, Esq. F.G.S.

The author, in this paper, announced the fact, that the great Appalachian coal field of North America extends southwards as far as lat. 33° 10′, where it is covered up with beds of the cretaceous period. The coal is worked in open quarries at Tuscaloosa, near the centre of Alabama, and is there associated with carbonaceous shales, containing many fossil vegetable remains, recognized as of the same species as those found in the mines of Ohio and Pennsylvania. The strike of these coal beds is N.E. and S.W. The coal in this district appears to occupy the highest place in the carboniferous series of deposits, and with it occur white quartzose sandstone and grits, reposing on shales and clays containing seams of coal of less value. These are of considerable thickness, and overlie a great deposit of quartzose grit, passing downwards into thinly laminated sandstones. Next succeeds a group of fetid limetones, with chert resting on another limestone, in which occurs what seems to be a bed of brown hæmatite of vast thickness. The Alabama coal fields may be considered as forming three basins, of which the most western is not less than 90 miles long, and from 10 to 30 miles across, and the eastern is of nearly as great extent. The third is to the north, and appears to be of smaller dimensions.—*Trans. Geolog. Soc.*

Athenæum.

JOURNAL

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NOVEMBER, 1846.

CIVIL ENGINEERING.

Report of the President and Directors of the Harrisburg, Portsmouth, Mountjoy and Lancaster Rail Road Company to the Stockholders, September 4th, 1846.

The Directors of the Harrisburg, Portsmouth, Mountjoy and Lancaster rail-road Company, in compliance with the Charter, respectfully submit to the Stockholders the Annual Statement of the affairs and business of the Company for the fiscal year ending September 1st, 1846.

Since the last Annual Report of the Directors, the proceeds of the sale of Stock, authorized by act of Assembly, and sanctioned by the Stockholders, has been applied to the purchase of T rail to relay the road, and to the payment of a large portion of the floating debts of the Company (principally under judgment) that have been due and remained unpaid for a considerable length of time; and also to the payment of the deficiency of interest not provided for in the assignment, amounting to over five thousand dollars.

The decayed and defective condition of the flat bar road between Elizabethtown and Harrisburg, compelled the Directors, late in the season, to contract at once for the iron, and commence the work as early and as speedily as possible. Arrangements were made with the Montour Iron Company to furnish the first three hundred tons of T

rail made at their works. Owing to circumstances not within the control of the Directors, the first iron was not delivered until the middle of November, and then, only a part was received in time to be laid down before the frost set in. By extraordinary efforts, the Directors were enabled to relay, with a good and substantial T rail, nearly three miles of the worst part of the road, extending from the Conewago bridge over the roughest and most dangerous part. The remaining fifteen miles of the flat bar road was repaired, and put in as good and safe order before the winter commenced, as the decayed state of the timber would admit.

During the winter, arrangements were made and contracts entered into, to furnish timber for the construction and relaying the whole fifteen miles between Elizabethtown and Harrisburg with a strong T rail; but subsequently, owing to the high price of rail-road iron, and the great difficulty of procuring it, and the impossibility of obtaining sufficient funds to complete the work and raise the assignment, without too great a sacrifice to the Company's interest, the Directors were induced, by a regard to economy and durability, to renew the superstructure on the balance of the road. Sensible that nothing but waste of money, labor and materials, would attend the repairing of the fifteen miles of old track, they determined to relay it with whole flat bars, using in part the perfect bars taken from the old track, the balance being made up by the purchase of new iron.

The manner of constructing the road is as follows: first, longitudinal string pieces of timber, 8 by 10 inches, and from 20 to 60 feet long, are laid on the bed of the road, spliced and pinned together with locust pins; secondly, at intervals of 9 feet, cross-ties of white oak, 3 by 8 inches, and 6 feet long, are mortised in and spiked fast; thirdly, on the string pieces a ribbon or plank of white oak, 3 by 4 inches, and from 15 to 24 feet long, is well fastened and secured; fourthly, on this plank or ribbon the flat bar is laid, and firmly spiked down; all the joints, both under and above the ribbon, are well saturated with gas tar. This plan, after careful consideration, has been adopted as the most judicious both in regard to economy as well as durability. It will be observed, that the height of the ribbon and flat bar is $3\frac{5}{8}$ inches, or just the height of the new T rail. By this mode of construction the flat bar and ribbon can at any time be taken off, and replaced with the T rail at very little trouble or expense.

The eighteen miles of track, from Dillerville to Elizabethtown, laid with T rail, is in good order, and has as yet required but little new material in the repairs; all that was needed, has been the adjusting the sills and cleaning the ditches in order to drain and keep the road dry.

The whole road is now nearly completed: when finished, it will be in better order and safer for traveling than it ever has been since its construction, and will not suffer in comparison with the best roads of the kind in the country. The Company will then be enabled to run the whole road from Dillerville to Harrisburg in less than two hours; and there is no doubt, with this improved condition of the road, by judicious management, a saving may be made to the Company of more

than ten thousand dollars in the next year's expenses, in repairs of road, passenger and baggage cars, in fuel, and in the wear and tear of machinery.

The *Bridges* across the Big and Little Chickesalunga and the Conewago streams are in very fair order: they will, however, want new flooring as a better protection to the timber from the weather and fire.

The Company have contracted for, and are now building under the bridge over the Swatara creek, two additional and substantial stone piers, to be finished by the first day of November next. This bridge was constructed with but one pier, and is 310 feet long. In consequence of the spans being thus reduced to one-half their former length, the Company will be enabled, without materially obstructing the business of the road, to rebuild the bridge in a more substantial manner, in less time and at less cost, than to have it built on the old pier.

The *Bridge* over the Pennsylvania Canal above Middletown, has been rebuilt; it is now a good and substantial structure.

The *New Bridge* across Paxton's creek, which was carried from its place by the late freshet, has been replaced and repaired; it is now in excellent order. The small bridges and the culverts, on the line of the road, which were all likewise more or less injured by the freshet, have also been rebuilt or put in good repair.

The *Tunnel* is in good order; it is kept free from obstructions, and will require but little to keep it in repair.

The *Locomotives* now in use are in very good order, considering the time they have been running on the road. Two of them, the Henry Clay and C. B. Penrose, have lately undergone a thorough repair; both have been furnished with new fire boxes, flues, &c., and are now in excellent condition: they are considered nearly as good as new, and unless an accident happens, will require but little or no repair for a considerable time.

The *Passenger* and *Baggage cars* have been repaired and improved during the last year, and are now in excellent order.

The *Real Estate* belonging to the Company at Harrisburg, consists of car house and offices, machine shop and depot, five ware-houses with water slips, extra water slip, wharf, and two lots. The buildings are all rented, or in use by the Company, with the exception of two of the warehouses. The rents for the present year amount to one thousand seven hundred and fifty dollars. The company have also several lots of ground and water houses, at Dillerville, Elizabethtown and Middletown, which are now used and occupied as water and wood stations.

The *Weigh Scales* at Harrisburg, which have been out of use for some time, have been taken up, and replaced with new scales, at a point on the road more convenient for weighing; these scales were manufactured by Messrs. Ellicott & Abbot, and weigh over twenty tons: so far as they have been tested for correctness and strength, they fully meet the expectations of the Board of Directors.

It will be seen by reference to the tables, and by comparing the statements annexed, with the last year's business, that the receipts for passengers alone have increased $5478.66, and that for the same time

the receipts for freight have increased $7856.42; making the total increased receipts for passengers and freight of $13,335.08 in favor of the present fiscal year over the last.

Statement of the whole Receipts and Expenditures of the Road and Company for the Fiscal Year, commencing September 1st, 1845, and ending August 31st, 1846; also with the balances of Cash on hand, taken from the Accounts of the Trustees, Treasurer and Superintendent.

1845.		
Sept. 1.	To cash on hand, - - -	$2,933 67
	To cash received from passengers, freight, mails and rents, - - - -	91,703 43
	To cash received from sale of old materials,	1,005 00
	To " " Company's stock, authorized by Act of Assembly, -	40,000 00
	To cash received from sale of T rail-road iron,	3,412 50
	To cash received from Messrs. Craige and Roberts, attorneys, - - - -	2,820 00
	To cash received from sundries, - -	39 39
		$141,913 99

Disbursed as follows, viz:

	By cash paid interest on Company's loans,	$35,343 04
	By cash paid for T rail-road iron, timber for new track, chairs, spikes, &c. - -	41,981 52
	By cash paid this amount of Company's loans and debts, - - - -	14,999 97
	*By cash paid expenses proper for the road,	31,989 55
	By cash paid S. Craige and A. S. Roberts, attorneys, on account of the assignment, -	8,820 00
	By cash paid expenses of trust, - -	1,050 00
	By cash paid on account of salary of President and Secretary, office rent, &c. - -	2,564 14
1846.		
Sept. 1.	By cash in hands Treasurer and Trustees, -	5,165 77
		$141,913 99

For a more detailed statement of the receipts and expenditures reference may be had to the annexed statements, No. IV, V, and VI.

Abstract of Receipts from Passengers, Freight, Mails, Rents, &c. for the past Year.

Receipts	from passengers, - - -	$60,538 83
Do.	freight, - - - - -	23,509 97
Do.	mails, - - - - - -	6,300 00
	Amount forward	$90,348 80

*The expenses for the month of August are not included in the above item.

Amount brought forward		$90,348 80
	Receipts from rents,	1,750 00
Do.	sale of old materials,	1,005 00
	Total income for last year,	$93,103 80

The statement shows that the receipts for passengers is $60,538.83, equal to $1.38 on an average for each through passenger. The number of miles traveled by passengers is 1,567,056, being equal to 44,-337¾ through passengers.

The eastward tolls on freight amount to	$11,326 46
The westward tolls on freight amount to	12,183 51
Total, eastward and westward,	$23,509 97

A more detailed statement will be found by reference to Tables Nos. I. and II. annexed to this Report.

The following statement shows the amount and character of the Company's loans and debts; from which it will be seen, by comparing the present statement with the last year's report, that the debts of the Company have decreased more than $20,000 within the last year.

1. Five per cent. sterling bonds, sold in London redeemable in 1858, £64,500 stg. at $4.85,		$312,825 00
2. Six per cent. dollar bonds, issued in United States, redeemable in 1858,		236,300 00
3. Certificates, letter F, for fractional amounts, convertible into bonds, payable in 1858,		1,567 64
4. Debts funded, for which bonds have not been issued,		17,153 00
Total funded until 1858,		$567,845 64
5. Amount due Salomons, on iron notes,	$38,300 00	
6. Bills Payable, not yet due,	15,043 82	
7. Certificates payable, not yet due,	2,200 00	
		55,543 82
8. Certificates payable, and other claims,		2,507 25
Total,		$625,896 71

Although the amount of revenue derived from the road during the past year is very flattering as regards the future prospects of the Company, while the expenses proper have been little more than those of last year; nevertheless, the general expense account will appear heavy, owing in part to the appropriation made to the reconstruction of the wooden or flat bar track, which was entirely worn out and very unsafe to travel on, and in part to repairs of injuries caused by the great flood in the Susquehanna river in March last. On this occasion the water rose to an unprecedented height, carrying away and destroying more than a mile of the Company's road, displacing the new bridge over Paxton's creek, and injuring more or less nearly all the culverts and

road bridges on the line between Elizabethtown and Harrisburg, some of which had to be entirely renewed. By the indefatigable exertions of the Company's superintendents, viz. Messrs. William P. Beatty and Kirk Few, the whole road was, however, put in traveling order in less than a week from the time the repairs commenced.

In closing this Report to the Stockholders, the Board of Directors have not ventured any estimate of revenue for the ensuing year; but they flatter themselves, from the increase of receipts of the present year over the last, under circumstances so manifestly unfavorable to the Company, that when the road is completed and the assignment removed, the nett receipts will be amply adequate, after paying interest on all the loans and debts of the Company, to pay a fair dividend to the Stockholders.

All of which is respectfully submitted.

By order of the Board of Directors,

JOSEPH YEAGER, *President.*

September 4th, 1846.

No. VI.

Statement of the Amount of Expenses incurred by Superintendent, from September 1st, 1845, *to September 1st,* 1846.

1.	Repairs of roadway, bridges and superstructure, between Elizabethtown and Dillerville, 18 miles iron track, - - -	$1,025 68
2.	Repairs of roadway, bridges and superstructure, between Elizabethtown and Harrisburg, 18 miles wooden, or flat bar, track, - -	7,224 33
3.	Repairs and improvements of depots, machine shops, warehouses, water stations and new weigh scales,	579 75
4.	Repairs of locomotives and tenders, -	3,642 48
5.	Repairs of passenger and baggage cars, -	1,698 49
6.	Wood, - - -	4,468 15
7.	Coal, - - -	333 45
8.	Oil and cotton waste, - -	868 46
9.	Wages of engineers and firemen, - -	4,117 00
10.	Wages of laborers engaged in pumping water, tending switches, sawing wood, watching bridges and depots, - - -	2,251 58
11.	Carrying passengers in flood and mails to post offices,	466 85
12.	Removing snow from track, - -	87 93
13.	Insurance on Harrisburg property and taxes, -	755 64
14.	Attorney's fees and legal expenses, -	517 06
15.	Printing and stationery, - -	161 07
16.	Salaries of superintendents, collectors and conductors,	3,875 68
17.	Rent of engines and cars to D. Lapsley, trustee, -	1,800 00
18.	Old debts paid, incurred prior to Sept. 7th, 1842, -	32 96
19.	Damages by flood, &c. - -	396 56
20.	Amount paid for materials and labor in reconstructing the Company's road, -	21,787 91
		$56,100 82

Extract from the Report of the Directors of the West Flanders Railway, to the Shareholders.

Railway traffic has rarely been found to fall short of the estimates, where such estimates have been based on any reasonable principle; but it is in the cost of works that the great errors have been committed. It is therefore an important feature in this undertaking, that the works are light throughout, and liable to none of those contingencies, which, where heavy works are to be executed, must arise, and which disturb and frequently render nugatory, the most careful calculations. They have also with much care revised their calculations with reference to traffic, availing themselves of the information which the accumulated experience on the Belgian lines affords. In this examination they have been materially assisted by the statistical returns of the Government lines, and by a work of M. Desart, the Government Engineer and Divisional Inspector, recently printed. The results brought out by this examination have, in the judgment of the Directors, a most material bearing on the case of the West Flanders lines, and they tend to confirm, in a remarkable manner, the principles on which the lines were adopted, and on which their success was anticipated. The Directors consider it therefore desirable to give them at some length to the Proprietors. The statements worked out from the Government traffic returns establish, beyond all doubt, the following principles, viz.: that the number of passengers between two towns connected by a railway does not depend only on the population or commercial importance of those towns, but most materially on the distance between them. Thus the number of passengers will be greater on a line connecting a succession of small towns and villages, situated as they generally are in England and Belgium, than on a line of equal length connecting two large towns. In proof of this, during the year 1845, Brussels sent—

Passengers.		Kilometres.			Miles.
57,726	to Vilvorde,	10	distant,	about	6¼
76,232	" Malines,	20	"	"	12½
94,698	" Antwerp,	44	"	"	27¼
38,359	" Louvain,	44	"	"	27¼
14,717	" Termonde,	47	"	"	29¼
11,000	" Terlemont,	62	"	"	38½
39,443	" Ghent,	76	"	"	47¼
4,732	" St. Trond,	86	"	"	53¼
21,322	" Liege,	114	"	"	76¾
4,147	" Courtrai,	120	"	"	74½
6,177	" Bruges,	121	"	"	75
2,200	" Vervieres,	139	"	"	86¼
3,283	" Tournay,	151	"	"	93¾

Brussels, it is shown, sent 57,726 passengers to Vilvorde, a town of 4,000 inhabitants, and of no commercial importance, but only 10 kilometres (about 6¼ miles) distant; 76,232 passengers to Malines, a town with a population of 24,000, and of very small commercial impor-

tance, but only 20 kilometres from Brussels (about 12½ miles); 38,359 passengers to Louvain, a town quite as important as Malines, with equal population, but 44 kilometres (about 27¼ miles) from Brussels, more than twice the distance between Brussels and Malines; and 39,443 passengers to Ghent, a town with a population of 96,000 inhabitants, and of great commercial importance. The number of passengers are thus about the same between Brussels and Ghent as between Brussels and Louvain. It has already been observed that Louvain is unfavorably situated with regard to distance, being 44 kilometres (about 27½ miles) from Brussels. The number of passengers between Brussels and Ghent was not above half as many as between Brussels and Malines. The reason is, that Ghent is 76 kilometres (about 47¼ miles) from Brussels, and Malines only 20 (about 6¼ miles.) Again in 1845, Malines (24,000 inhabitants) sent—

			Kilometres.			Miles.
32,448	passengers to	Antwerp,	24	distant,	about	15
5,218	"	Termonde,	27	"	"	16¾
7,028	"	Ghent,	55	"	"	34¼
757	"	Bruges,	100	"	"	62

But what is more striking is, that Ghent, with its population of 96,-000, and great commercial importance, should, in the year 1845 have sent only 13,439 passengers to Antwerp, a town of 78,000 inhabitants, and also of great commercial importance. These two towns being, as M. Desart remarks, the Manchester and Liverpool of Belgium. On the other hand, Malines, comparatively unimportant, sent 32,448 passengers to Antwerp. The explanation is, that Ghent is 79 kilometres (about 49¼ miles) from Antwerp and the railway most circuitous; and Malines is distant only 24 kilometres (about 15 miles). As a further illustration :—Suppose Ghent, which is ten times as important a place as Termonde, to be at the same distance from Brussels as Termonde is, viz., 47 kilometres (about 29¼ miles), Brussels ought to send ten times as many passengers to Ghent as it now does to Termonde, that is to say 14,717 multiplied by ten, or 147,170; whereas in 1845, Brussels, with its population of 140,000, and its importance as capital of Belgium, sent only 31,443 passengers to Ghent. Such a result can only be accounted for by the respective distances between the places connected by the State Railway. Mons. Desart has reduced these facts to a system. By calculations founded on the population and situations of the towns and villages connected by the Government railways, and on the number of passengers moving between the different stations, he has succeeded in forming a table, showing the average number of passengers on the State lines from 2 kilometres (about 1¼ mile) to 250 kilometres distance (about 155½ miles.) According to this table, which is drawn up with great care, the number of passengers goes on increasing at a very rapid rate from 2 to 9 kilometres (between 1 and 5 miles.) The climax is at 9 kilometres (about 5½ miles.) From that distance the number diminishes. When the distance between two places is excessively small, the number of passengers by railway is also small. The most productive distance consequently is from 8 to 10 kilometres (between five and six miles.)

Railway Mag.

Account of Experiments with the New Locomotive Engine "the Great Western."

On June 13th an experimental trip was made on the Great Western, from London to Bristol and back, for the purpose of trying the tractive powers of the new monster engine "The Great Western." The train weighed 100 tons, and consisted of ten first class carriages, seven of which were ballasted with iron, the other three being occupied by the directors and those interested in the experiment.

The train started from Paddington at 11 hour 47 min. 52 sec. It passed the 1st mile-post at 11 hour 51 min. 1 sec., and came abreast of the 52nd mile (immediately after which the breaks were put on for the stoppage at Didcot), at 12 hour 45 min. 24 sec., running, therefore, the 51 miles, with a rise of 118 feet, in a few seconds over 54 minutes, or at an average speed of upwards of 56 miles an hour.

At Didcot a stoppage of 5 min. 15 sec. took place. The mile-post beyond Didcot, viz. the 54th, was passed at 12 hour 54 min. 27 sec., and the 75th mile-post (just after passing which the breaks were put on for the stoppage at Swindon) was reached at 1 hour 18 min. 6 sec., the distance of 21 miles having been passed over in 23 min. 39 sec., or at the average rate of upwards of 54 miles an hour.

At Swindon there was a stoppage of 4 min. 27 sec. The 78th mile-post was passed at 1 hour 29 min. 30 sec., and the 98th mile-post, which is a short distance on the Paddington side of the Box Tunnel, was reached at 1 hour 49 min. 26 sec., the 20 miles having therefore been accomplished in 19 min. 56 sec., or at upwards of a mile per minute. The train came abreast of the 117th mile post at 2 hour 12 min. 3 sec. This gives the time occupied in running the distance between the 78th and 117th as 42 min. 33 sec. for the 39 miles, or something like 53 miles per hour.

The maximum speed on the down journey was obtained between the 83rd and 92nd mile-posts. From the 80th to the 84th mile there is a falling gradient of 8 feet per mile, and from the 85½ to about the 86½ mile there is a falling gradient of about 1 in 100, and a fall of 8 feet per mile then reaches to about the 90½ mile-post; a rising gradient of 8 feet per mile then succeeds, and extends beyond the 22nd mile-post. The train came abreast of the 83rd mile-post at 1 hour 34 min. 56 sec., and passed the 92nd mile-post at 1 hour 43 min. 8 sec., performing the 10 miles in 9 min. and 8 sec., or at an average speed of nearly 66 miles per hour. The 87th and 88th miles, on a fallen gradient of 8 feet per mile, were run over at the rate of *sixty-nine* miles per hour.

The train arrived at Bristol about 15 min. past 2. thereby making the time occupied in starting from a state of rest to coming to a state of rest, or, in other words, from platform to platform, 2 hours 26 min., including stoppages, which averages a rate of 50 miles per hour.

At Bristol, a collation awaited the invited guests, Mr. C. Russel, M. P., in the chair. In the course of his speech he took occasion to remark that a greater speed might have been attained, had not one of the pumps for supplying the boiler with water given way shortly after passing Slough, to remedy which they were under the necessity

of reducing the pressure in the boilers. The train afterwards returned to London. Mr. Brunel drove the engine both ways.

The principal dimensions of this great locomotive are—Cylinders, 18 in. diam. and 2 ft. stroke; driving wheels, 8 ft. diam,; supporting wheels, 4 ft. 6 in. diam.; has six wheels and uncoupled; 278 tubes, 9 ft. long and 2 in. diam.; fire-box outside, 5 ft. 6 in. by 6 ft.; inside, 4 ft. 10 in. by 5 ft. 4 in., with a partition through the middle, giving 169 ft. of heating surface, and 20 ft. for area of fire-grate; total heating surface, 1750 ft.; from level of rail to top of cylindrical part of boiler, 9 ft. 6 in.; and from level of rail to top of chimney, 14 ft. 8 in.; supporting wheels 16 ft. apart, with the driving wheels in the centre; total length of engine, 24 ft.; tender on six wheels; weight of engine, 30 tons; tender, 15 tons. Civ. Eng. & Arc. Jour.

History of the Railway Gauge.

In England 1900 miles have been constructed on the narrow gauge, and 274 on the broad. No public railways in England are at present laid down on an intermediate gauge, those which formerly existed having been reduced to the prevailing dimensions of 4 ft. 8½ in. The mineral railways of England vary from 2 ft. to 4 ft 8½ in., the latter only being worked by steam. In Scotland the passenger gauge is 4 ft. 8½ in. In Ireland, under the advice of a Goverment Commission, 5 ft. 3 in. has been adopted as the national gauge, although some short lines have been laid down on 4 ft. 8½ in. In France the railways are, under Government instructions, universally laid down on the narrow gauge. In Belgium the first series of railways laid down by Government were all on the 4 ft. 8½ in. gauge with the exception of one line between Ghent and Antwerp, which is laid down on a gauge of 3 ft. 9 in. In Brunswick the railroads are on the narrow gauge, as they also are in Saxony, Austria, and Bavaria. In Italy, between Leghorn and Pisa, there is a narrow gauge line, and those lines which are being constructed between Genoa and Turin are also on the narrow gauge. In Holland a gauge of 6 ft. 4 or 6 in. has been employed, and in Baden a 5 ft. 3 in. gauge. The railway between Basle and Strasburg is on a gauge of 6 ft. 3 in.—*The Railway System Illustrated.*

Min. Jour.

Railway Speculation in 1845.

A curious document has come to light, in the shape of a report from the Registrar-General of Joint Stock Companies to the Privy Council for Trade, for 1845. It forms a gigantic index of upwards of 50 folios to the doings in railway speculation for the past year, and can be likened, in its length and curious disclosures, to nothing else but the ramifications of a Welsh pedigree, or Homer's catalogue of ships. An interesting biography, or book, upon bubbles might be wrought out of it in the hands of a judicious selector. It is, moreover, a mirror of that memorable period of national hallucination when every bubble

was invested with a value, as the true offspring of the joint-stock genius of England, by the then reigning epidemic of speculative cupidity and caprice. In the return every scheme is impaled as nicely as ephemera in the folios of a naturalist. Each scheme is accurately named and numbered so that all whom it concerns may take notice, and see how the multiplied schemes that came out starred with premiums have given up the ghost of a moonshine existence, and found a place in the catalogue of all defunct things. This list is an eloquent *éloge* of the wild spirit of project and speculation that characterised the past, and will be highly useful to the posterity of speculators and projectors in all time to come. The report is but a record of the establishment of the evil of a plethoric speculation, without at all unveiling the disastrous and uncalculating consequences that followed the most puissant period of speculation in the world's history; consequences that can only be adequately arrived at by diving into the depths of woe and Whitecross street, which is said to be half peopled with speculators and projectors, who had a chief hand in the late railway game of hazard. The list consists of 53 pages, and contains the titles and specifications of 1520 schemes, the offspring of 1845—the majority being for railways, water companies, banks, insurances, mines, and an immensity of other joint-stock corporations. The year opened with a mere handful, but, as the days rolled on and the fever became fiercer, they doubled, trebled, and quintupled in quantity, until, in September, October, and November, they came thickly thundering on, at the rate of from 100 to 300 and 500 a-month, and an average in September—the most prolific of all months—of from 16 to 46 each day, or 457 in the month, as will be seen by the following analysis of the return. In December, when the panic rang the tocsin of alarm, and the excitement was gradually subsiding, the climacteric was 31.

The following shows the number of projects registered each month, with the aggregate totals for the same :—

	No. Registered.	*Total.*		*No. Registered.*	*Total.*
January	16	16	July	91	401
February	30	46	August	175	573
March	25	73	September	457	1035
April	52	126	October	363	1401
May	81	218	November	86	1488
June	90	309	December	31	1520

Total schemes registered from January to December 1520

The Gauge Commission.

Analysis of Evidence given before the Royal Commissioners appointed to investigate the subject of the diversity of Railway Gauges.

Continued from Page 234.

Joseph Locke, Esq.—is the engineer who completed the Grand Junction Railway. This line was opened to the public in 1837. When

witness assumed the office of engineer on this line, the rails and sleepers had been contracted for, the bridges designed, and some portion of the work commenced for the narrow gauge. Alteration of gauge at this time would have been attended with considerable expense ; narrow gauge selected for this line because surrounded on all sides with lines of similar gauge, and it was desirable to preserve uniformity of gauge in the district. Great Western Railway not commenced at this time. Narrow gauge rails may be laid down on a broad gauge railroad, so as to carry on the narrow gauge traffic continuously ; this process is very expensive, and in reference to the stations, very inconvenient. Where two gauges meet, the station by this plan must not only be made larger but also of a different construction than if made for one gauge only. If called upon to project a series of railroads in a new country, would prefer an intermediate gauge, between 4 feet $8\frac{1}{2}$ inches and 7 feet; wide gauge not necessary for machinery ; carriages on narrow gauge lines can be made longer and loftier than at present, giving as much space to each passenger, three on a seat, as in those of the broad gauge, four or five on a seat.

Height of carriages on narrow gauge lines lately increased 6 or 8 inches. At high speeds higher wheels are necessary ; the centre of gravity would consequently be raised, rendering wider gauge than 4 feet $8\frac{1}{2}$ inches desirable ; at the same time, witness is of opinion, that looking to the construction of the road, the speed now attained is as great as is consistent with safety, and would neither increase the gauge, speed, nor size of wheels without more experience in the construction of engines and strength of materials ; inequalities of road from change of temperature and weather impossible to be overcome ; some engines on South Western Railway with wheels 6 feet 6 inches diameter, where the boilers are not higher than on engines with wheels 5 feet 6 inches ; this done by placing the cylinder outside the boiler, and bringing the boiler nearly on to the axle ; the centre of gravity as low with the large wheels as the small ones by this arrangement. No disadvantage caused from this change ; application of power outside the wheel does not produce a rocking motion. Great changes have been made on engines on narrow gauge lines, with a view to obtain increased power ; engines of enormous power have recently been constructed on North Midland Railway to carry heavy trains of minerals. Limited space between wheels and boiler in engines on narrow gauge lines caused some inconvenience in the attempts to obtain increased power. Turned his attention to improving the engine and altering the arrangement of machinery ; and now gets all necessary power on narrow gauge lines. Length of boilers on Grand Junction and South Western lines increased from 8 feet 6 to 9 feet 6.

Cannot tell the velocity attained upon the Great Western ; express trains on South Western line travel 40 miles, and could no doubt run 50 miles an hour. Does not think 50 miles an hour can be done with safety on any line that witness has been on ; is much opposed to such excessive speed. Curves more difficult to traverse with broad than

narrow gauge. Facility for turning curves in inverse ratio to the width of gauge.

Broad gauge gives greater facility for conveyance of heavy trains, by giving larger space to put the power in, but witness considers that as much and even more power than is necessary can be obtained on the narrow gauge; disapproves of throwing a large force upon one engine. Has heard of trains of 60 and 70, and in one instance of 77 wagons in one train; would altogether prohibit such trains; would divide them, and not allow more than 40 wagons, each weighing 5 or 6 tons, at one time; more than that number strains the wagons, the frames are thrown out of square, the chains are broken, and cause delay and inconvenience on the road. Would not have greater power than sufficient to drag 60 wagons; the engines on North Midland, with large boilers, cylinders, and fire-boxes, can drag 100 wagons; they generate more steam than they consume.

Wide gauge more expensive than narrow; it required longer sleepers, greater space for embankments, cuttings, &c.; Mr. Brunel of a contrary opinion; his calculations were founded upon using smaller timbers and lighter rails than he is now using. The South Western rail is 75 lb. to the yard: both the Grand Junction and the London and Birmingham were originally 65 lb.; have been recently increased to 75 lb. Increased expense of broad gauge would be in bridges, tunnels, cuttings, and embankments. Outside rail of Great Western nearer the slope or ditch than upon other lines; if engines get off the lines, more liable to fall over; witness prefers a wide embankment, and where possible, always gives addditional width. Estimates that a broad gauge transverse sleeper would cost 59 per cent. more than a similar sleeper on the narrow gauge. Ordinary width of embankments 30 feet, giving 7 feet on each side between edge and outer rail. In such roads, if engine got off one rail, it would remain on embankment; if off both rails, it would go over. Cannot say how far the extra width in Great Western engines would prevent them getting over the embankment. Would give a space of 7 feet beyond the rails in wide as well as narrow gauge lines.

Rails laid upon longitudinal bearings give greater elasticity to the work, and tend to throw the engines and carriages off the line; tried with longitudinal bearings two viaducts, Dutton viaduct, and Birmingham viaduct, and could never keep them in order; considers the principle bad; prefers transverse sleepers. This opinion the result of actual observation. Railways laid with transverse sleepers more easily repaired than a longitudinal road.

Has not seen the contrivances used at Paddington for transferring traffic from one gauge to another. Believes the transfer can easily be made. The machine itself very simple; the practical difficulty is in use of carriages carrying loose-box bodies to be transferred; a machine was formerly used on Liverpool and Manchester for lifting loose coal-boxes; machine excellent, and saved much labor, but the boxes were so much broken and injured in lifting, that the contrivance was abandoned; carriages with loose bodies are not so strong as others; in event of collision passengers would be in more danger in such car-

riages. On certain French lines the diligences are put on loose wheels, placed under the frame, and with a little hoist lifted upon the body of the carriage, and put upon the truck of the railway, just in the same way as a gentleman's carriage, and taken off in the same manner, and dropped on to a frame of four wheels at the end of the journey. The contrivance is very simple and very facile; but not very safe. They take the truck as it stands when the diligence is loaded; there is first of all a truck made for the diligence. It is not a truck with a simple bottom to it, but has sides to it, and it is then like an ordinary truck; and I believe that when the diligence is upon the track, it is certainly not so strong as if it were part of the same carriage, but it is very heavy, and they carry a weight upon the Paris and Rouen line of eight or nine tons where the diligence is loaded; and if it were not for the change, you might have a weight of only about five or six tons, so that in every carriage you are carrying a great deal of dead weight in order to avoid the necessity of changing the carriages. There was a collision on the Orleans Railway by some sudden stoppage; one of those very diligences was thrown off its position.

Engines on narrow gauge lines are not all made with outside cylinders; on Grand Junction line, about one-half are so made, and others, as they are repaired, are altered upon the new system; but even with cranked axles, the arrangements of machinery are so simplified and compressed, that no inconvenience is felt from want of space. No difference in construction of horse boxes on broad and narrow-gauge lines. Greater speed on Great Western attributed to their having better gradients, fewer stoppages, and larger engines than on narrow gauge. Has traveled on an engine with 6 feet 6 inch wheel (the largest wheel on narrow gauge) 50 miles an hour with ease; that engine capable of taking six or eight carriages 60 miles an hour; one of the new engines on Grand Junction, with only a 6 feet wheel, and expansive gear, recently traveled 57 miles an hour.

Believes that wherever a break of gauge occurs hereafter, either an entirely new line must be laid down, or a narrow gauge line laid upon broad gauge road. In the latter case, continuing the narrow gauge, and having the double gauge upon the shortest possible length, is the lesser evil of the two, and in all probability will be universally adopted. Break of gauge should take place where there is little traffic. An alteration of all the broad gauge lines to 4 feet 8½ inch gauge would be the cheapest mode of obviating the evil of different gauges. Believes the Great Western Company will find the inconvenience of break of gauge so great, that they will be compelled to lay down the narrow gauge from Oxford to London. Is not prepared to say at once that a change of broad to narrow gauge throughout would lead to the greatest economy, and greatest commercial advantage, because the officers of the Great Western Railway believe that the inconveniences attending a change of gauge are less than supposed by witness; could not, therefore, as a government officer, supposing all thef railways now made the property of government, advise a change o broad to narrow gauge without greater experience.

Reason of Engineer of Great Western Railway adopting wide gauge, after the Bill had passed through Parliament, supposed to be a desire to obtain greater speed, a better road, and greater economy of construction; one great item of expense in locomotive engines supposed to be the rapid reciprocation of the piston: and to diminish this was thought very desirable; but the expense of working locomotives on narrow gauge has diminished from 2s. 6d. to 2s., 1s. 4d. down to 10d. per mile run; it is very doubtful if the expense is not just as great on Great Western as on the narrow gauge; Mr. Brunel at first intended using wheels of much larger diameter than are used at present; wheels on Great Western formerly 10 feet in diameter; those now used only 7 feet; only 6 inches larger than those at present working on South Western Railway: the adoption of the broad gauge it was supposed would tend to diminish the working expenses; this result, however, has not yet been proved. Considers that a far higher speed can be obtained on narrow gauge lines than is compatible with safety. If desirable to change gauge of South Western to broad gauge, should take certain length, and use a single line; this is the practice when any substantial repair is in progress; when a mile or mile and a half of rail is taken up, using a single line, and keeping a policeman at each end. The tunnels on South Western line not large enough for broad gauge, and while enlarging these, the traffic must be stopped; the bridges and viaducts would also require alteration.

Has bestowed considerable attention to the construction of locomotives, particularly at the time the difficulty was first experienced in obtaining greater speed on narrow gauge lines. The first engines used on Grand Junction line of very inferior construction; the difficulty of obtaining greater speed on this line first induced witness to turn his attention to improvements in the construction of locomotive engines. Outside cylinders introduced on Kingston and Dublin line without outside frames; by this plan the cylinders overhung the frame too much. On Grand Junction line outside frames were used, but the outside bearings were attached to the front and hind wheels only; the cylinder by being attached to the driving wheels, without the intervention of the outside frame, kept the engine more compact. By this arrangement the width of engine was diminished several inches. Inside cylinder has necessarily a crank axle, and more liable to break; on Grand Junction line, accidents from this cause formerly a source not only of expense but of danger, as the crank broke when the train was in motion, and often threw it off the line. Has not had a single accident from breakage since the introduction of outside cylinders. Engines getting off the line not of frequent occurrence; more so now than formerly, in consequence of the increased speed,

Tenders on Great Western line of greater capacity to contain water than on other lines, and run longer distances without changing. Tenders could be made for narrow gauge lines larger than those on Great Western if considered necessary: tenders upon Great Western line all upon six wheels; on other lines upon four wheels only. The 10-feet driving wheels on Great Western abandoned from the difficulty of getting engines large enough to move the trains at any ordinary speed,

and the further difficulty of stopping them when once started. Wheels of these dimensions not suitable on a line with severe gradients. By increasing the size of the wheel there will be a danger of the springing of the wheel itself on its motion, from the axle not being sufficiently rigid. In going through points or crossings with a very large wheel, a very little force applied to the flanch will spring the wheel unless it is made proportionably strong, and if you do that you will have a wide boss; the bosses are 8 or 10 inches, the spokes are 4 or 5 inches, tapering up to 3 inches at the rim; if you increase it from 6 or 7 feet to 10 feet you must increase the width of your boss, and you will have a very heavy weight and very wide boss. Weight of largest engine on Southampton line, about 17 or 18 tons. No evil will result to the road by increasing the weight of the passenger engines.

Wagons on either gauge can be made to contain 5 tons; in the north of England, where so much more is carried than in the south, small wagons are still adhered to. Wagons upon both lines made to carry 10 tons of coals. Narrow gauge most convenient for side lines running to the pits. Relative cost of working trains at 16 miles and at 40 miles an hour about one-third more. Some engines on Grand Junction line burn 16 lb. of coke per mile. Probable consumption of express trains about 4 or 5 lb. per mile more; on Great Western the consumption is considerably more than this; they have larger and heavier engines; on South Western line the quantity of coke consumed per mile is considerably less than on Great Western.

There would be increased difficulty in the ordinary working as regards the maintenance of way, packing the rails, &c., if the narrow and broad gauge were combined. The easiest mode of maintaining the road would be, where you have the broad gauge, by transverse sleepers, and then putting a single rail upon one single sleeper; that is the best mode of keeping the road in repair: but it is not a good mode of laying the road for two carriages, nor is it convenient for working, because the centre of gravity is not in the same line. If you take two rails between the longitudinal bearings of the wide gauge, you have not space enough to put longitudinal bearings, unless you put them close together: and you cannot ram them; if you ram down one side you will run a risk of elevating the other rail; and in ramming down the inner rail you will run a risk of lifting it up out of the level on the opposite side; in fact, the want of the facility of getting to both sides of the baulk would be found a very serious inconvenience. Would propose, under those circumstances, to lay both rails upon transverse sleepers; and if railways were to be made in that manner, should certainly lay a large sleeper, long enough to take both gauges.

A considerable number of the transverse sleepers upon the Great Western Railway have been changed; their duration is very variable; those not well saturated decay sooner than others; their duration also affected by the nature of the soil. Construction of passenger carriages on Grand Junction line much improved; they are now made stronger and more substantial. They are now made solid instead of

being curved out. This change is adopted partly from economy and partly to obtain greater strength. Liverpool and Manchester Company began with very light carriages, considering that the lighter the carriages the less the draught; on the slightest collision they got out of the square; they have been gradually increased in strength up to the present time; they now weigh about 3 or 3¾ tons, but have not yet adopted the solid frame; cost more from the quantity of iron-work used in their construction. Reasons for the adoption of the solid frame were these:—In the bolt-holes in all these small scantlings of timber not more than 4 inches square, or 4 by 3, on taking a carriage to pieces, you found a little decay; that one corner of the bolt-hole gets a little larger, and there is a little play; consequently it has to be renewed far sooner than if it had been a solid and substantial piece of timber, for the least decay in a small piece of timber renders it unfit for its work, and it must be renewed. Upon seeing this at the Grand Junction workshop at Crewe, witness advised the directors to abandon entirely the construction of the carriages on that plan, and to adopt the solid frame; and they now have carriages with solid frames. Considers the public safety much increased by the alteration. Many engineers entertain a different opinion, and consider that very high velocities may be obtained with much lighter carriages than those now used; Mr. Brunel and Mr. Cubitt are both of opinion, that by the atmospheric system, they will be able to keep the road in better order, use lighter carriages, and go at greater speed than has hitherto been attained on any of the locomotive lines. Witness altogether disapproves of light carriages, and considers that with them accidents are more frequent, and when occurring, more dangerous than with the stronger carriages. Safety of train depends greatly upon weight of engine which draws it. If the engine were a light engine, at the speed at which it sometimes travels, it would leave the rail; but as it is heavy, it gives security to the train behind it. Recent accident on Great Western line, where all the light carriages were more or less damaged, while the strong one, in the same line, was scarcely strained. Sleepers can be renewed on transverse system at much less expense than on continuous bearings. Estimated expense of one mile of permanent way, £4,838:—

		£	s.	d
Rails, 75 lb. per yard	236 tons at £11	2596	0	0
Chairs	56 tons " £9	504	0	0
Sleepers	2 640 " 5s.	660	0	0
Ballast	9,680 yards " 1s. 6d.	726	0	0
Laying Road, including Spikes and Keys, 3520 at 2s.		352	0	0
	Total	4838	0	0

The prices of Rails, Chairs, and Ballast are variable.

Civ. Eng. and Arch. Jour.

(To be continued.)

List of American Patents which issued in the month of October, 1845,—with Exemplifications, by Charles M. Keller, *late Chief Examiner in the United States Patent Office.*

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1. For improvements in *Machinery for Making Firkins and other Coopers' work;* William Trapp, Jr., Dryden, New York, October 1.

We are under the necessity of omitting the claim in this instance, as it refers to, and depends entirely on the drawings, which are too complex to justify their publication.

The first section of the claim relates to the manner of turning off the surface of the firkin, or barrel, by means of a tool that slides from end to end, so guided as to follow the bilge of the firkin, the staves of which are held together by a chuck-plate at each end. The second section relates to the mode of chamfering, howelling, and crozing the ends of the barrel, by inserting it in a hollow cylinder, open at each end, to turn it, and then bringing the ends of the staves together by an iron chuck, so that the crozing, &c. tool can be presented to both ends. The third section relates to the crozing tool, which is made with a changeable face plate, to adapt it to both ends of the barrel. The fourth section relates to the peculiar manner of combining the parts constituting the tool for turning off the surface of the barrel. And sections five and six relate to the construction of the tools for howelling and chamfering.

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2. For improvements in the *Machine for Breaking and Cleaning Flax and Hemp;* Benjamin B. Smith, Hamilton county, Ohio, October 7.

This machine consists of a series of pairs of rollers, armed with slats arranged spirally, and the inclination of the slats is reversed on each succeeding pair of rollers, so that the action on the hemp or flax shall be reversed when passing from the first to the second pair, and so on. And the feeding rollers, which supply the hemp to the slatted rollers, have a vibratory motion, the effect of which is, alternately, to give the hemp to the slatted rollers and draw it back to strip the broken harl or wood from the fibres.

Claim.—" What I claim as my invention and desire to secure by letters patent, is the combination of a series of pairs of cylinders, each pair having spiral-formed slats or bars on them, the slats in each pair running in contrary directions from that immediately preceding, so as to break the hemp in several directions, as herein set forth.

" I also claim, in combination with the dressing-cylinder or cylinders; the vibrating motion of the feeding rollers, so as to draw the hemp in and out again, as before described."

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3. For an improved method of *Moulding Glass Knobs;* George O. Russell, Middletown, Connecticut, October 7.

The following claim fully expresses the nature and object of this improvement.

Claim.—"What I claim as my invention and desire to secure by letters patent, is moulding or casting the socket on a screw former, which can be withdrawn from the glass after it has solidified, and before it contracts sufficiently, by cooling, to split or crack, as described."

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4. For an improvement in the *Inkstand;* Walter Hunt, New York City, New York, assigned to Augustus T. Arrowsmith, of the same place, October 7.

The lower end of the tube which dips in the ink is inclined, and has a flap valve hinged to it, and borne up by springs to exclude the ink from the tube, except when the pen is dipped, which operation opens the valve sufficiently to admit the requisite quantity of ink.

Claim.—"What I claim as my invention in the above described improvement, and desire to secure by letters patent, is the application of an air inclined valve or clapper, having a surface of glass, or other hard, smooth material, in combination with said inclined valve and ink-tube; which valve is forced upwards by means of springs, or otherwise, upon the bottom of the ink-tube, and arranged substantially in the manner and for the purposes above set forth and described."

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5. For an improvement in the *Plough;* Thos. B. Quigley and Harvey Hall, Mansfield, Ohio, October 7.

Claim.—"What we claim as our invention and improvement, and desire to secure by letters patent, is the combination of the adjustable wheel with the adjustable beam, as described."

The beam is made adjustable by turning on the screw that connects with the standard, and its rear end is connected with the handle by an adjusting screw, by the turning of which, the plough is made to take more or less land. The wheel is placed back of the mould-board, and between the heel and wing, and its tread is conical, the larger diameter being towards the land-side, "to crowd the rear of the mould-board from the land, and keep the front of the plough towards the land."

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6. For an improvement in the *Machine for Ruling Paper;* Lewis Edwards, Norwich, Connecticut, October 9.

Claim.—"What I claim as new, and for which I ask letters patent, is the causing the pens to be raised by the edge of the paper, in its passage through the machine, thus causing each sheet to determine the length of its own lines."

The sheets of paper are placed on the apron at the required distances apart, and the motion of the pens, towards or from the paper, is governed by a set of stops hung to an arber, so that when these stops are acted upon by the edges of the sheets, the pens are operated; in this way, the extent of the lines is regulated by the spaces between the sheets.

7. For an improvement in the *Process of Manufacturing the Chromate of Potash;* Isaac Tyson, Jr., Baltimore, Maryland, October 9.

Claim.—"Having thus fully described the nature of my improvement in the process of manufacturing the salts of chrome, what I claim therein as new, and desire to secure by letters patent, is the using of wood ashes in mixture with the chrome ore, and with the alkaline salt, for the purpose and in the manner herein fully set forth."

The patentee says:—"My improvement consists in the use of a large proportionate quantity of wood ashes as a substitute for its equivalent of the carbonate of potash, or other alkaline salts; and this substitution is not made for the mere purpose of lessening the quantity of the alkaline salts of commerce which it may be necessary to employ, but I have proved, by careful experiment, that a larger quantity of the chromate is obtained from a given quantity of the ore, when wood ashes are thus used, than when the whole of the alkali is applied by the salts of commerce; the foreign matter contained in the wood ashes manifestly producing this effect."

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8. For an improvement in the *Planing Machine;* Benjamin Brown, Burlington, Vermont, October 9.

This is for an improvement on what is known as the Woodworth planing machine, and consists in the method of constructing an endless carriage, for feeding the board to the rotating planes. The carriage is made in sections, which are moved by a pinion taking into teeth in the middle of the sections, and at the end of their forward motion, the sections are made to descend by curved planes, and are carried back below, and by the same pinion, and at the other end they are raised in the same manner. A permanent strip, or board, fits in a space formed in each section where the cogs are made, for the purpose of guiding the sections, and to cover the cogs, and complete the surface of the carriage.

Claim.—"Having thus fully described my invention, I wish it to be understood that I do not claim an endless platform, formed of sections, nor do I claim the manner of moving them, they having been before used for a horse-power; but what I do claim as my improvement, and desire to secure by letters patent, is the endless sectional platform or carriage, such as herein described, which forms the bed for planing on in combination with the rotating cutters, in the manner and for the purpose set forth, whether the central bar be used or not; and I also claim the sectional platform or carriage in combination with the central bar, for the purpose and in the manner described."

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9. For improvements in *Friction Rollers,* for the boxes of railroad axles, &c.; Wm. Rowan, Great Britain, October 9.

This is for preventing the end play (and the friction arising therefrom,) of boxes on their axles when friction rollers are employed, by making the ends of the rollers bevelled and working against corresponding bevel flanches at each end, on the box and axle, the bevel be-

ing made with the proper pitch corresponding with the diameter of the axle and the roller, so that the bevel surfaces of the two, as they rotate, shall roll on each other, instead of rubbing.

Claim.—"I do not claim as my invention the employment of a series of rollers connected by rings at each end around the axle, and within a box, as this has long since been done; but what I do claim as my invention and desire to secure by letters patent, is making the ends of such rollers on a bevel or mitre, in combination with shoulders, collars, flanches, rings, or other projections on the axle and on the box or hub, having corresponding bevels or mitres to avoid the rubbing friction at the ends of the rollers, and the more effectually to prevent end play, substantially as herein described."

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10. For an improvement in the *Machine for Planing Shingles;* Joseph S. L. Hunt, Boston, Massachusetts, October 9.

Claim.—"My invention or improvement, and therefore that which I claim, consists in the employment of the perforated plate, in combination with the cutting cylinder and feed cutters; the whole being arranged and operating substantially as set forth."

The "perforated plate" is the bed on which the shingle to be planed is pressed by pressure rollers, as it is fed through the machine, and as the planing cylinder (similar to the common planing machine,) is applied below the bed, it, the bed, is cut out, or "perforated," that the rotating plane may act on the under surface of the shingle. In other words, the "perforated plate" may be called a double bed plate, one on each side of the planing cylinder."

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11. For improvements in *Machinery for Splitting and Driving Shoe Pegs;* John C. Briggs, Saratoga Springs, New York, October 11.

We are again under the necessity of omitting the claim, as numerous drawings would be necessary to enable the reader to understand it. The object of the inventor, however, is to form the pegs and drive them into the shoe by the same operation, appropriate cutters being arranged for this purpose in the driving tube.

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12. For an improvement in the *Spring Latch for Doors;* John Palmer, East Haddam, Connecticut, October 11.

Claim.—"I am fully aware that there is nothing new in the employment of a lever and a connecting bar for the purpose of withdrawing or retracing, or otherwise giving motion to an article of mechanism, and therefore I do not lay claim to such; but that to which I do lay claim, is the combination of a screw-pin with the connecting bar, in such manner as to be applicable to the shank of the knobs, or detachable therefrom, as herein described."

The connexion between the latch bolt and the "shank" or spindle of the knobs, is by means of the "connecting bar," (a common joint link) which is jointed to the back end of the latch bolt, and to a pin that screws into the spindle of the knobs, so that by unscrewing this pin the spindle and bolt can be disconnected.

13. For improvements in the *Machine for Cleaning or Burring Wool;* Thomas S. Washburn, Lowell, Massachusetts, October 11.

Claim.—"I shall therefore claim the peculiar manner in which the grate bars are made, so as to operate in connexion with the cylinders, viz: triangular in cross section, so as to present an acute angular or sharp edge for the teeth of the cylinders to act against, in order to remove the burr or burrs, as described.

"I also claim a toothed fan and grate, in combination with the main and picker cylinders F and G, and grate H, the whole being arranged and used, in connexion with a feeding apparatus, substantially as above described."

There are two picker cylinders, lettered F and G, the teeth of the one (F) take the wool from the feed rollers and carry it around to the second toothed cylinder (G,) which, in turn, delivers it to the fan, the wings of which are provided with bars armed with teeth. The two cylinders and the fan are partly surrounded by concaves of angular bars, the angles being towards the cylinders, that the wool may strike against them as it is carried around.

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14. For an improvement in the *Machine for Cleaning Wool;* Alanson Crane, Lowell, Massachusetts, October 11.

Claim.—"Having thus fully described the nature of my improvement in the manner of constructing the fine comb cylinder of a machine for the burring and cleaning of wool or cotton, what I claim therein as new, and desire to secure by letters patent, is the constructing of said cylinder by covering its periphery with metallic plates of such width as may be desired, and extending from end to end thereof, on which plates grooves or channels are to be cut, and the teeth to be formed on one of their edges, in the manner and for the purpose herein fully made known."

The metal plates are placed on a cylinder like staves, or lags, with a space between each, and then these are grooved in the direction of the periphery, and the edge which is to act on the wool is then bevelled towards the cylinder, which leaves a series of pointed teeth. This is for an improvement on the machine patented by Calvert & Crane, on the 16th of July, 1841.

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15. For an improved method of *Replacing Cars that have run off the track;* Samuel H. Bean, Philadelphia, Pennsylvania, October 11.

Claim.—"What I claim as my invention and which I desire to secure by letters patent, is replacing cars that have run off the track, by drawing them up longitudinal inclined planes, formed on blocks of any suitable material, connected together and placed in front of the several wheels, and thence on the transverse inclined planes formed on said blocks, immediately in front of said longitudinal planes, and terminating on a level with the rails, down which, said wheels are

caused to slide, by the gravity of the car, to their proper positions on the track, as set forth."

16. For an improvement in the *Self-detaching Link for Connecting Railroad Cars;* Richard Hemming, Boston, Massachusetts, October 11.

The patentee says:—"The nature of my invention consists in providing the link with a segment of a circular flanch above and below, embraced by corresponding recesses in jaws, (one of which is jointed,) in the end of the draft beam in one of the cars, the centre of the circle of the flanches corresponding with any point desired between the two cars, so that the flanches shall slide in the recesses when the cars deviate from a straight line, but shall slide entirely out when either of the cars run off the track."

Claim.—"What I claim as my invention and desire to secure by letters patent, is connecting railroad cars, locomotives, &c., by a link provided with a segment of a circular flanch or flanches, embraced in the manner herein described, which will be liberated when the bodies, thus connected, deviate sufficiently from the line of the road, substantially as described, in combination with a spring joint, as herein described, to facilitate the liberation of the link when the car, &c. leaves the track, by a motion upward or downward, as well as horizontal, as set forth."

17. For improvements in the *Machine for Cutting Shingles;* A. S. Pelton, Clinton, Connecticut, October 16.

The leading object of this machine is to make shingles with a portion of the length towards the butt, with the two surfaces parallel, instead of making them tapering the whole length, as usual. For this purpose, the carriage that carries the block up to the knife is connected with the operating slides at points between the ends of the block and the middle, so that, as one end is fed up to the knife, the other point of connexion becomes the fulcrum, and thus carries back that end of the block which is beyond the connexion with the slide; hence, all that portion of the block will not be acted on by the knife, and the butt end will be formed as pointed out above.

The slides which operate the carriage are placed in the middle, and are hollowed out to embrace a cylinder whose surface is so formed as to operate these slides alternately. This groove is first diagonal to move forward the slide, and then in the direction of the periphery, to hold the slide still during the operation of the knife, and then diagonal, and so on to the end.

Claim.—"What I claim as my invention and desire to secure by letters patent, is connecting the carriage with the slides (or slide) that operate it, at some points between the middle of its length and the ends of the block, so that at each vibration one end shall be moved forward and the other back, as herein described, to form the shingles with the part towards the butt with parallel faces, as specified.

"I also claim operating the two sliding blocks that carry the carriage, by means of a groove, formed as herein described, in the surface of

one cylinder, so that one of the slides shall remain still whilst the other is moved forward, as described. And, finally, I claim connecting the rod that moves one end of the carriage, with its appropriate sliting block, by means of a slide, governed by an adjustable screw, or other analogous device, for the purpose of adjusting the face of the block or bolt of wood to the knife for the cutting of the first shingle, as described."

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18. For machinery for *Manufacturing Forks;* Samuel H. Gilman, Boston, Massachusetts, October 16.

Claim.—"Having thus fully described the nature and operation of my improved machinery for manufacturing forks and other articles of a like character, what I claim therein as new, and desire to secure by letters patent, is the manner in which I have combined and arranged the respective parts of the machinery for cutting, filing, or dressing the handles, as herein described; that is to say, I claim the manner of arranging and combining the revolving cutters, or files, the pattern by which the form to be given to the handle is governed, the rocking frames which carry the cutters, and the sliding frame, being made to co-operate in their action substantially as set forth.

"In that for dressing the prongs, I claim the combination of the revolving wheels, with their cutters, and with the rests which pass in between said wheels, for the purpose and substantially in the manner herein made known."

In the machine for dressing the handles, there are two cutter or filing wheels, the spindles of which are each hung in a rocking frame, the two being forced towards each other and against a pattern, so that as the carriage carrying the fork passes between the two cutter wheels, they are made to approach and recede, to give the required curve to the handle. And in the machine for dressing the prongs, there are several bevel cutter wheels placed on a shaft, side by side, the toothed surfaces of any two forming a V groove. And the rests that carry the forks and sustain the prongs are so formed as to pass in the grooves formed by the different cutter wheels.

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19. For improvements in *Safe Locks;* William Hall, Boston, Massachusetts, October 16.

Claim.—"I do not claim two series of sliding plates or tumblers, arranged side by side, and the one series having recesses in each plate, and the other series having corresponding projections to enter and move in the said recesses, and the one series being affixed to the main bolt, so as to move back and forth, as well as up and down with it, and having a corresponding series of notches or indents in each of its plates, and one spring catch applied to or affixed upon the main bolt, which spring is thrown, by a suitable projection, from the lock case into one of the notches of each of the several plates, whenever the bolt is shot forward by the key, and out of the same, by a similar contrivance, when the bolt is retracted, (the projections of the front series of

plates being carried so far forward, or out of the recesses of the rear series, when the bolt is thrown forward, or locked, as to permit of the fall or vertical depression of each of the plates of the rear series of plates,) all of which will be found to exist in certain locks heretofore patented or sold; but that which I do claim is my specific improvement thereon, the same consisting in the combination with the main bolt and two series of sliding tumblers, constructed and acting together, as above set forth, of a solid stud, (projecting from the bolt;) the slots (cut as above described, in the tumblers of the front series) and a vibrating or moving plate applied to the main bolt and rear series of tumblers, as specified, the whole being arranged and operating together substantially as herein before explained."

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20. For an improvement in the *Bark Mill;* Isaiah Scudder, assigned to Milo J. Wilton, Broadalbin, New York, October 25, ante-dated April 25th, 1845.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the lower part, or second mill, which receives the bark from the upper and discharges it through the side or bottom of the mill, or both, by the aid of arms or flanches attached to the hub or shaft, which force the bark through grater or double saw teeth, whichever are used."

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21. For an improvement in the *Rotary-Top Cooking Stove;* Henry Stanley, West Poultney, Vermont, October 25.

Claim.—"Having thus fully described the manner in which I now construct my rotary top stove, what I claim as new therein, and desire to secure by letters patent, is the combining with a stove furnished with a rotary top an oven occupying the whole area of the lower part of the stove, and furnished with flues, arranged and governed in the manner herein set forth. I do not claim either the manner of forming the oven, or of arranging the flues, as in itself new; but I claim them only in their combination with the rotary-top stove, by which that stove is rendered much more convenient and efficient than under any former construction thereof."

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22. For improvements in the method of *producing and multiplying Copies of Designs;* Carl F. Baldamus and F. W. Siemens, Berlin, Prussia, October 25.

Claim.—"Having now described the nature of our improvements in producing and multiplying copies of designs, and impressions of printed or written surfaces, we would have it understood that we do not confine ourselves to the details shown and described, provided the peculiar character of the arrangements or processes be retained. We would also have it understood that we make no claim to many of the separate parts herein described, but what we claim is—

"1st. The described process, whereby we transfer by means, of treating the originals with acids of strengths varying with the in-

duration of the ink, and so pressing out the acid as to cause an etching of the blank spaces, and a reversed impression of the original (where protected from the action of the acid) on metallic surfaces.

"2d. The process of reviving the printing ink on originals, by first acting on them with caustic potash on its carbonic and tartaric acid, so as to form cream of tartar in the paper, which prevents the adherence of fresh ink in the blank spaces, while the old ink is left in a state to take up an additional quantity from a roller passed over it.

"3d. The herein described process of preventing the adhesion or sticking of printing ink, during the operation of printing, to any part of the plates which are required to remain blank, by acting upon such blank surfaces with acid preparations of phosphorus."

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23. For improvements in the *Apparatus for Purifying Sugar, &c.*; Ethan Cambell, New York, October 25.

Without drawings, we could not convey to our readers a clear idea of this apparatus, and as the claim refers to, and depends entirely upon the drawings, we are under the necessity of omitting it.

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24. For an improvement in the *Piano Forte;* Edward Badlain, Potsdam, New York, October 25.

Claim.—"Furthermore I claim as my invention the adaptation of the above described shutters in said board that prevents the sound from escaping only at the pleasure of the player on the piano forte; I also claim as my invention the above described arrangement of the shutters, as connected with the pedal, to give the motion of the shutters by the use of the pedal; I claim, also, as my invention, the combining the swell with the piano forte, by means of a covering over the strings, and having shutters in said covering, as above described, so as to confine the sound; and, with the use of the pedal, as above described, the shutters in said board are made to open and shut, gradually or quickly, at the pleasure of the player, and can produce the crescendo and diminuendo tones, or swell in the piano forte, as above described; and, by opening and shutting the shutters quickly, the player can produce the explosive and pressure tones by the above described mode, by the use of the pedal."

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25. For an improved *Composition of Matter for Earthenware, &c.;* Joel Farnum, Stillwater, New York, October 25.

The ingredients are:—Pulverized Ochre, Soap Stone, Ground Marl, each 1 part; Alum dissolved with water, ½ part; Kaolin or Ground Feldspar, Barytes ground fine, Ashes and Brine, each 1-16th part. Mix together well for use.

Claim.—"What I claim as my improvement, or invention, and desire to secure by letters patent, is the combination of materials and proportions, as embraced in this application, for making into various articles that the composition will admit of, by moulding, twining or

pressing, burning, and glazing, which is a great improvement for some articles over clay, in use of ochre."

26. For an improvement in *Bedstead Fastenings;* Ira Smith, assigned to Adin Gauntz, Chagrin Falls, Ohio, October 25.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the hook and key, constructed in the manner set forth, crossing each other, and thereby forming a double inclined plane, so that by turning the key they are locked, and the joints drawn tight, as herein described."

The lock is a piece of metal projecting from the ends of the end rail and passing into the post; it is made with curved and inclined surfaces. And the key is another piece of metal projecting from the ends of the side rails, and also entering the post, and crossing the hook. This key has a lip, or projection, which, when turned, catches on to the inclined surface of the hook, and draws the side rail up tight to the post. And it has also an eccentric projection, which acts against a shoulder on the hook, to draw the end rail tight.

27. For an improvement in the *Machine for Cutting and Grinding Fodder:* Jesse Urmy, Wilmington, Delaware, October 25.

The patentee says:—"The nature of my invention consists in arranging cutters that project at right angles with the face of a wheel called the runner, to which they are attached, for slitting fodder, &c., and another set of knives, parallel with the face of the said wheel, for cutting off, with a beveled edge, provided with oblique teeth, corresponding with a like set of teeth on the permanent plate, for grinding or crushing the material which has been slit and cut, so as to perform continuously the operations of slitting, cutting, and crushing or grinding."

List of American Patents which issued in the month of April, 1842 *—with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an improvement in *Piano Fortes;* Thomas Loud, Philadelphia, Pennsylvania, April 1.

All the parts of the action are attached to, or connected with, a sliding frame governed by a pedal, so that the hammers, by the motion of the pedal, can be so moved as to strike either one or the two strings, to increase or decrease the tone.

Claim.—"What I claim, therefore, as constituting my invention, and desire to secure by letters patent, is the manner herein described in which I have combined and arranged the movable frame to which the action of a square or horizontal piano forte is attached, with the pedal, lever, guides, stops, and springs, so as to cause the action in such a piano forte to move from back to front, or in the direction necessary to govern the hammers, and to cause them to strike upon one

or more strings at pleasure. The whole combination being substantially the same with that herein set forth."

2. For an improvement in the method of *Supplying Air to all kinds of Furnaces;* Edward A. Stevens, Bordentown, New Jersey, April 1.

Claim.—"Having thus fully described the nature of my invention, and set forth some of the advantages to be derived therefrom, what I claim therein as new, and desire to secure by letters patent, is the combining with a steam engine, or other furnace, an air-tight apartment or fire-room, into which room air is to be forced by means of a suitable blowing apparatus, so as to increase the density or pressure of the air to such extent as may be desired for supplying it in sufficient quantities to the burning fuel; the whole being so constructed and arranged as to effect the purposes, and substantially in the manner, herein set forth."

3. For an improvement in the *Lock for Mail Bags;* H. C. Jones, Newark, New Jersey, April 1.

The object of this improvement is so to arrange the bolts that they will not liberate the shackle by striking the case of the lock to make them react. This is effected by having two bolts that pass through the shackle in opposite directions—one a sliding bolt (designated in the claim by the letter E,) and the other a turning bolt, (designated by the letter F.)

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the slide bolt and the turning bolt passing through the shackle, constructed and arranged as above described."

4. For an improvement in the *Cultivator for Cotton;* Wm. A. Rogers, Sommerville, Alabama, April 1.

The frame is triangular, the back end of the beam being attached to the middle of one of the sides of the triangle, and thence passing through the junction of the other two sides. Vertical wooden teeth project downwards from the under face of the three sides of the triangle.

Claim.—"What I claim as my invention and which I desire to secure by letters patent is the manner of arranging the back and side rows of teeth in combination with the frame and beam as above described for cultivating cotton."

5. For an improvement in *Journal Boxes for oiling Journals;* John Shugert, Elizabeth, Alleghany Co., Pa., April 1.

Claim.—"What I claim as my invention and desire to secure by letters patent, is, the arrangement of the reservoirs of oil on each side of the box, their bottom being on a level with the bottom of the box, and being provided with channels leading thereto, in combination with gudgeons or journals made larger than the shaft next to the box, so

that the oil in the bottom of the box may be high enough for the journal to revolve in, and not leak out of the opening in the box, through which the shaft passes, all as herein described."

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6. For an improvement in the method of *Mounting Looms for Weaving Bolting Cloths*; Rollin White, Williamstown, Orange Co., Vt. April 1.

The patentee says—"In the Weaving of Bolting cloths it is necessary to put one, two, or more twists into the threads which constitute the warp, between each thread of filling, for the purpose of preserving the meshes of such cloth of equal size, by preventing their being forced nearer together, or further apart, either in the process of manufacturing them, or in their subsequent use, than would be compatible with the purpose to which the cloth is to be applied; and have, as I verily believe, devised a mode of effecting this which is more simple than, and equally perfect with, any that has been heretofore adopted. In the loom in which this is effected there is not anything peculiar, the object being attained by the particular manner in which the harness is made to operate on the warp."

Instead of having each warp thread to pass through a loop in a corresponding heddle, as in the usual mode of mounting for other kinds of cloth, every alternate warp thread passes through a heddle, and that heddle passes over the warp thread next to the one that passes through the heddle, so that by each operation these two warps are coiled around each other.

Claim—"Having thus fully described the nature of my invention and shown various modes in which the same may be carried into operation, what I claim as new therein and desire to secure by letters patent, is the within described manner of giving one or more twists to the threads of warp, between each thread of filling in the weaving of bolting cloths or other fabrics in the manufacture of which such twist may be required, the same being effected by passing a portion of the heddles around the threads of warp, substantially in the manner set forth."

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7. For an improvement in the *Coulter of Ploughs;* Howard Deland, Mottsville, Onondaga Co., N. Y., April 1.

Claim—"What I claim as constituting my invention and desire to secure by letters patent, is the combination and employment with a plough of a revolving coulter which is serrated or furnished with teeth around its periphery, so sharpened as to constitute cutting edges and to operate substantially in the manner herein set forth. I do not claim a revolving coulter, which consists of a circular plate with a smooth cutting edge, such having been previously known and used; but limit my claim to the foregoing improvement of forming sharp teeth or serratures around it."

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8. For improvements in *Sofa Bedsteads;* Joel Pratt, Hartford, Ct., April 1.

The following claim indicates clearly the nature of these improvements, except that the "folding ends" are double and open like a book, the folding half of each end when open forming the support for the back of the sofa when it is let down for a bed.

Claim—"What I claim as my invention and which I desire to secure by letters patent is, 1st. constructing the sofa with folding ends so as to admit of being opened to form a support, and head and foot board for the back when let down to form a bed, as described. 2nd. the falling back in combination with the turning rail as described. 3rd. the mode of attaching the turning front rail to the permanent ends in combination with the dove-tailed connexion of the back rail as described, by means of which combination the sofa can be put together and taken to pieces so as to render it portable, as above described."

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9. For improvements in *Saw Mill Dogs;* George Henning, Ithaca, N. York, April 1.

We are under the necessity of omitting the claims in this instance, as they refer to, and are wholly dependent on the drawings which are too complex for insertion, as the patent is only granted for slight improvements on previously known methods of setting logs on the carriages of saw mills.

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10. For an improvement in the *Machine for Cutting Sheet Metal;* Mahon Gregg, Wilmington, Del., April 1.

The sheet of metal to be cut by the rotating shears is placed on a rest connected with a carriage by means of a bolt so that the carriage can move the sheet nearer to, or farther from the shears, whilst the turning of the rest admits of the presentation of the sheet at any desired angle.

Claim:—"What I claim as my invention, and which I desire to secure by letters patent, is the combination of the carriage and turning rest with the circular revolving cutters for cutting sheets of metal to any required angle, as described."

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11. For a combination of Mechanism called the *Naval Automaton;* John Adolphus Etzler, Philadelphia, Pa., April 1.

This invention is intended for a variety of purposes, and is more magnificent in the conception than it ever will be in practical results.

By means of a wind mill, cog wheels, drums, ropes, &c., the force of the wind is to be employed in managing the sail of the vessel which is fan shaped, one half on each side of the mast, so that it can be furled by being drawn up on either side. This limits the application of the wind, the waves are to be differently employed.—Large boards are placed below the keel of the vessel and connected therewith by means of jointed arms, levers, &c. so that as the vessel rises and sinks by the action of the waves, the boards remain uninfluenced and therefore by the connexions give motion to the various connecting arms and levers,

which impel machinery of any kind on board the vessel, as well as paddles for propelling the vessel.

We deem it unnecessary to insert the claim, as the originality of the invention is not likely to be called in question.

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12. For an improved process for *Separating Stearine and Elaine;* John H. Smith, Brooklyn, New York, April 1.

Claim:—"I am aware that alcohol has been used for the purpose of separating elaine and stearine from each other in analytical chemistry; but the lard or other fatty matter consisting of these substances, has, in this case, been dissolved in the heated alcohol and the whole has been suffered to cool together; this process would be altogether inapplicable to manufacturing purposes, as the cost would exceed the value of the product. In my manufacturing process, instead of dissolving the lard in alcohol, I add a small proportionate quantity of the latter to the former, the whole of which is driven off at an early period of the ebullition, but by its presence, or catalytically disposes the elaine and stearine to separate from each other, which they do after long boiling, and subsequent cooling. I do not therefore claim the use of alcohol in separating elaine and stearine from each other, by dissolving the fatty matter in heated alcohol and by subsequently cooling the solution; but what I do claim as my invention and wish to secure by letters patent, is the within described method of effectively promoting their separation, by incorporating alcohol, or highly rectified spirits with the lard in small proportionate quantities, say one gallon, more or less, of such alcohol, or spirit, to eighty gallons of lard, and then boiling the mixture for several hours, by which boiling the whole of the alcohol will be driven off, but will have left the elaine and stearine with a disposition to separate from each other, on subsequent cooling, as herein indicated and made known.

Decision of a Suit brought by ZEBULON PARKER, *in the Circuit Court of the United States, for the District of Ohio, December Term,* 1843, *for an Infringement of his Patent for a Water Wheel, by* WILLIAM HATFIELD.

ZEBULON PARKER, *vs.* WILLIAM HATFIELD. } In Chancery

On motion of complainant's council it is ordered that the complainant have leave to file a supplementary and amended bill in this case. It is further ordered that this case be, and the same is, hereby referred to Catharinus P. Buckingham, Esq., of the county of Knox, as special master, who shall, at the request of either of the parties, witness, at such place as he may deem convenient, such experiments as either of the parties may make in his presence, in relation to the improvements by them respectively claimed, and take such further testimony as either of the parties may offer, or he may deem necessary; notice of the time and place of such experiments, or of the taking of such testimony

shall be in writing, and served so as to allow one day for every twenty-five miles travel: and service on Mr. Delano of Mount Vernon shall be good service on defendant, and service on Mr. Smythe of Newark shall be good service on complainant. And it is further ordered that the said master have power to examine either of the parties under oath, at the request of the other; and that said master report to the next Term the result of such experiments, and the evidence by him taken;—and also his opinion touching the following matters:—

First. Whether the invention claimed by complainant was new and useful; and should he so find, that he then report the particulars in which it is new, and wherein consists its utility.

Secondly. Whether the complainant's patent is valid;—and if not, the reason of its invalidity.

Thirdly. Whether the invention claimed by defendant, or the water wheel made, vended, or used by him is an infringement on complainant's rights under his patent; and if so wherein.

Fourthly. The amount of damage sustained by complainant, by reason of the infringement of his rights under said patent by the defendant; and that he do not omit reporting upon this branch of the inquiry because of his reporting unfavorably to complainant upon the second branch thereof; should he do so.

To the Honorable the Circuit Court of the United States, within and for the Seventh Circuit and District of Ohio.

The report of C. P. Buckingham, special Master Commissioner, appointed in the cause in chancery,—pending in said court, wherein Zebulon Parker is complainant, and William Hatfield is defendant.

The said special Master Commissioner reports to your honorable Court, that in pursuance of the order made in said cause at the December term of said Court, A. D. 1843, he has examined said cause; and that from the pleadings, exhibits, and testimony on file in said cause, he finds:—That on the 19th day of October, 1829, a patent was issued to Zebulon Parker and Austin Parker for "an improvement in the application of hydraulic power," which improvement consists, according to the specification of the patent: 1st. In placing several wheels, (always an even number) on one shaft, and conducting the water to them through spouts which wind between concentric cylinders, producing thereby a whirling or vertical motion of the water in the same direction with that of the wheels; 2nd. In a contrivance for introducing the water into a single horizontal wheel with a circular motion; together with an improvement in the construction of the wheel itself; 3rd. In a contrivance for applying the same principle to common wheels now in use.

At a subsequent period Austin Parker deceased, and his administrator, Robert McKelvey, conveyed to Zebulon Parker all his interest in the invention and subsequent improvements, by deed dated November 2, 1839. On the fourth day of October, 1843, the patent was extended to the term of twenty-one years from its original date, upon the petition of Zebulon Parker.

On the 31st. December, 1838, William Hatfield obtained a patent for an improvement on Parker's percussion and reaction wheel, consisting, according to the specification, of the peculiar form of the buckets, and the double spiral scroll placed between them for directing the water.

In his answer to the bill filed against him by the complainant, the defendant claims that his invention was denominated "an improvement on Parker's percussion and reaction wheel," by mistake, and that the wheel for which he obtained his patent was wholly his own invention.

The first question asked by the Court in their order is, "whether the invention claimed by the complainant was new and useful; and should he so find, that he [the Commissioner] then report the particulars in which it was new, and wherein consisted its utility."

The invention claimed by the complainant consists of several parts or particulars. Each of these will be examined separately. The first particular is the arrangement of several wheels upon the same horizontal shaft. There is nothing in evidence to show that this invention was not *new*. The only evidence on this part of the subject is that of Isaac Dillon, who is uncertain whether the wheels he heard of as being used by George Girty at Dresden on one shaft, was prior to the use of Parker's wheel or not. Next as to its utility. The word useful, as applied to an invention does not necessarily imply an improvement upon all former methods of obtaining the same end. So far as its *comparative* merits are concerned, it is a matter of some importance to the inventor in a pecuniary point of view, because upon this will depend the profits which he may derive from the exclusive right secured to him by his patent; but it is certainly a matter of no importance to the public. The office of the Government in granting a patent is that of *Protection.* It operates on the one hand to secure to the inventor, the benefit of his own talents and industry for a limited period, on condition that at the end of this period these benefits shall be enjoyed by the public at large; and on the other to prevent injury to the public by the encouragement or protection of such inventions as are mischievous in their character. However small may be the *merit* of the invention, the public can be no loser, for the benefit of its protection will be small in proportion. The *character* of the invention then is the only thing which the government has to look to in reference to the public interest; and it is in reference to this, and this alone, that the word useful is applied in the patent; it simply means a capability of being applied to a beneficial purpose, and is opposed to that which is mischievous and injurious in its natural tendency. Mr. Justice Story (in Bradford *vs.* Hunt, 1 Mason 302,) says, "by useful inventions in the statute of 1793, C. 156, is meant such a one as may be applied to some beneficial use in society, in contradistinction to an invention which is injurious to the morals, the health, or the good order of society. It is not necessary to establish that the invention is of such general utility as to supersede all other inventions now in practice to accomplish the same purpose. It is sufficient that it has no noxious or mischievous tendency; that it may be applied to practical uses, and that so far as it is applied it is

salutary. If its practical utility be very limited it will follow that it will be of little or no profit to the inventor, and if it be trifling it will sink into neglect. The law however does not look to the degree of utility, it simply requires that it shall be capable of use, and that the use is such as sound morals and probity do not discountenance or prohibit."

In an action for an infringement of a patent—for an improvement in the construction of pumps the same judge said that, "It was contended by the defendant that it was necessary for the plaintiff to prove that the invention is of general utility; so that in fact for the ordinary purposes of life it must supersede the pump in common use; in short that it must be for the public a better pump than the common pump; and that unless the plaintiff can establish this position, the law will not give him the benefit of his patent, even though in some particular cases his invention might be applied with advantage. I do not so consider the law. The statute 1793, C. 156, uses the word *useful* invention merely incidentally: it occurs only in the first section, and then it seems merely descriptive of the subject matter of the application, or the conviction of the applicant: neither the oath required by the second section, nor the special matter of the defence allowed to be given in evidence by the sixth section of the act, contains any such qualification, or reference to general utility, to establish the validity of the patent; nor is it alluded to in the tenth section as cause for which a patent may be vacated. To be sure all the matters of defence, or of objection to the patent are not enumerated in these sections; but if such a one as that now contended for had been intended, it is scarcely possible to account for its omission. In my judgment the argument is entirely without foundation." (Whittemore *vs.* Cutter, 1 Gallison 429,435.)

In this sense then the invention is certainly *useful*, inasmuch as it is not pretended that it has in any sense a mischievous effect upon the public.

The particulars in which this part of the invention is claimed to be *new* are, the position of the shaft, (being horizontal) and the number of wheels attached thereto. Its utility consists in the convenience of attaching the shaft directly to the saw without the intervention of gearing; in avoiding friction, by placing the wheels in pairs, so that the water will press equally each way in a direction parallel with the shaft, and in permitting the power of a low head as applied to the same shaft to be increased to the utmost extent of the supply of water, by increasing the number of pairs of wheels.

The next particular of the invention claimed by the complainant, to which the first question of the Court will be applied, consists of the concentric cylinders and the manner of supporting them.

No evidence has been adduced to show that this part of the invention is not new, nor can there be a doubt of its utility in the sense which we have assumed as belonging to the word. The particulars in which this part of the invention is claimed to be new, are, a hollow cylinder with an interior diameter nearly equal to that of the wheel,

another cylinder which is solid, (except the cavity for the shaft to run in,) and concentric with the first. These cylinders are placed between the two wheels, and serve to give the water a circular or whirling motion by passing between them before striking the wheels. Connected with these cylinders and essential to them is the manner of supporting them, which is simply by enclosing their ends in plank rims attached to the frame work of the forebay. The utility of these cylinders consists in the whirling or vertical motion which they give to the water before it reaches the wheels. This motion is in the direction in which the wheel moves, and causes the particles of water as they pass out at the issues to act at a greater angle against the inner sides of the buckets. Every wheel propelled by the action of the water upon the inclined surfaces of the buckets placed around its circumference, with issues for the water to pass freely out, may be said to act by percussion. For the particles of water being urged by the pressure of those behind, in endeavoring to escape in every direction, outwardly, act upon these inclined surfaces just as the force of the water is exerted upon the lee board of a boat crossing the stream by the force of the current. Now it is clear that if by any means a direction be given to the current, which shall coincide with that of the boat, before it strikes the board, it will serve to propel the boat faster. This is just the effect of the cylinders in question: but it is by no means clear that the inner one is *essential* to produce this result.

The next particular of the invention claimed by the complainant is "the spouts which conduct the water into the wheels from the penstock, and their spiral terminations between the cylinders."

This part of the invention is, also, both new and useful. The novelty of these spouts consists of their spiral terminations. Their utility consists in their conveying the water more easily and with less friction to the inside of the wheels, where it can act at once upon the buckets.

These particulars have reference in every case to the arrangement of several wheels upon a horizontal shaft; similar particulars are claimed by the complainant in the invention, as applied to single horizontal wheels upon a vertical shaft; and to these particulars the foregoing observations will apply in the same way.

Another part of the invention claimed by the complainant is a contrivance for applying the principle of vertical, or circular motion of the water to reaction wheels now in use. This contrivance is both new and useful in the sense in which those above described are so. Its utility consists in giving to the water a circular motion as it enters the wheel, to act upon the buckets or issues.

The next question proposed by the Court is "whether the complainant's patent is valid." There is nothing in the evidence which goes to show its invalidity. If then it is invalid, it must appear on the face of the patent itself. The two principal considerations to be applied to the question are, whether the invention is one of a nature to entitle the inventor to a patent therefor; and whether the provisions of the law are complied with in the manner of making the specifications. And *First* :—the invention is one which consists mainly of

these parts: 1st, a contrivance for applying the water more advantageously to the buckets of the wheel, by giving it a whirling motion; 2nd, a combination of wheels upon one shaft, for the purpose of increasing power and avoiding friction; 3rd, an improvement in the reaction wheel, by making the buckets as thin at both ends as they safely can be made, and the rim no wider than sufficient to cover them.

By the sixth section of the act of Congress passed July 4th, 1836, it is provided that "any person or persons having discovered or invented any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement in any art, machine, manufacture, or composition of matter," &c.

The first part of this invention may very properly be denominated a "new and useful machine," being a contrivance consisting of cylinders and their supports with the spiral spouts between. It can be described, made and sold; and each and every part, whether combined or separate, may be made the subject of exclusive right, and is therefore clearly entitled to a patent.

The second part of the invention may properly be called an improvement on a machine, by means of a new combination of things which were before in use and well known. It is true the inventor entitles it "the compound vertical percussion and reaction wheel," but this title is evidently applied to the COMBINATION, since the several parts consisting of the shaft and wheels were well known before.

In the case of Moody *vs.* Fisher 2 Mason 112, Judge Story says, "Where a patent is for a new *combination* of existing machinery, or machines, and does not claim or specify any improvement or invention except the *combination*, proof that the machines or any part of their structure existed before forms no objection to the patent, unless the *combination* has existed before; for that reason the inventor is limited to the combination." This part of the invention has therefore nothing in its nature which destroys the right of the inventor to a patent.

The third part of the invention is the improvement in the reaction wheel by making the buckets as thin at both ends as they can safely be made and the rim no wider than sufficient to cover them.

This part of the invention claimed by the complainant does not seem to be of a character to entitle the inventor to a patent. It is called an *improvement*, but it contains nothing which sufficiently differs from the old wheel to make in any sense a new machine of it. It consists merely of a slight variation or change in the form or proportions of a wheel long in use, without in any way changing the mode by which the water acts upon the wheel, nor the effect of such action. Judge Washington in Gray & Asgood *vs.* James and others, 1 Pet. C. C. R. 396, says, "what constitutes a difference in principle between two machines is frequently a question of difficulty, more especially if the difference in principle is considerable and the machinery complicated. But we think it may safely be laid down as a general rule that where machines are substantially the same, and operate in the same manner to produce the same result, they must be in principle

the same. I say *substantially*, in order to exclude all formal differences, and when I speak of the same result, I must be understood as meaning the same kind of result though it may differ in extent. So that the result is the same, according to this definition, whether one produce more nails for instance in a given time than another, if the operation is to make nails."

This wheel then claimed by the complainant must be considered as substantially the same wheel as the one before in use, and therefore not entitled to a patent.

Secondly :—Is the invention so described in the specification as to correspond with the requirements of the statute? These requirements are, that it shall be in such clear, full and exact terms, avoiding unnecessary prolixity, as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound and use the same. It would be difficult to imagine a description more clear and distinct than that given of the complainant's invention in the specification of his patent. The form, proportions and mode of construction of every part seem to be as accurately described as the nature of the case will permit. The patent cannot be objected to on this account. The only point of doubt then as to the validity of the patent is, whether that part of the invention said to consist in the "improvement of the reaction *wheel*," not being entitled to a patent, is sufficient to invalidate the whole. Judge Story in Moody *vs.* Fiske, 2 Mason 112, says, "when the patentee claims anything as his own invention in his specifications, Courts of law cannot reject the claim; and if it is included in the patent and found not to be new, the patent is void; however small or unimportant such asserted invention may be; where he sums up the particulars of his invention and his patent covers them, he is confined to such summary; and if some part which he claims in his summing up as his invention proves not to be in fact his invention, he cannot be permitted to sustain his patent by showing that such part is of slight value or importance in his patent. His patent covers it, and if it be not new the patent must be void." Now the alleged improvement in the water wheel consists in a simple change of form of the buckets and the proportions of the rim. This change, though slight and not involving a sufficient difference from the old wheel to form a new machine in any sense, and therefore not entitled to a patent, is nevertheless, so far as there is any alteration, the invention of the complainant, so that he does not claim any thing that he has not invented: though a part of that invention would not be entitled to a patent. The said Commissioner is therefore of opinion that the patent in this respect is valid; though this opinion is expressed with some hesitation.

The third question of the Court is "whether the invention claimed by the defendant, or the water wheel made, vended, or used by him is an infringement of the complainant's rights under his patent, and if so, wherein." The improvements claimed by the defendant in the summing up of his specification, are "the peculiar form of the buckets, and the double spiral scroll placed between them." The specification itself however describes the wheels as placed in pairs on a

horizontal shaft, and the scroll as being placed in a "concave" resembling an ogee. The spiral scroll, the combination of the wheels, and the "concave," are all of them, undoubtedly, infringements on the rights of the complainant under his patent; the two first items being precisely the same as those described in the patent of the complainant, and the "concave" being nothing less than the "outer cylinder" of the complainant, and which principally acts in producing the vertical or whirling motion of the water.

The fourth question of the Court is the amount of damage sustained by the complainant, by reason of the infringement of his rights under said patent, by the defendant.

The only evidence touching the number of wheels made and put into operation by defendant is that of S. R. Chandler, and of Martin Chandler, Jr. The former says that he knows of the defendant building a mill on a fork of Salt Creek, in Muskingum county, and others in the neighborhood; that he has seen the wheels used by Hatfield, and that they are identical with his own (one of complainant's,) except his was made of iron, and those put in by defendant of wood. The latter says, he never saw but three of defendant's wheels in operation, and he thinks there is no material difference between them and complainant's. It would seem then, that no more than three wheels have been proved to have been put into operation by the defendant, the damages for which, at the price demanded by the complainant for each right would amount to seventy five dollars.

In the month of July, 1844, at the request of the complainant, the undersigned notified the parties that he would attend at the house of the complainant for the purpose of witnessing a series of experiments having reference to this cause. Owing to the alleged illness of the defendant he did not attend at the time appointed, and afterwards protested against the experiments made in his absence being used as evidence. In the month of May last, after due notice to both parties, the experiments were repeated, defendant being still absent.

After full investigation of the matter the undersigned became satisfied that the experiments (of which the object was to test the relative merits of complainant's invention) had no bearing upon the question at issue between the parties, and therefore no notice was taken of them in the investigation of the subject.

All of which is respectfully submitted.

C. P. Buckingham,
Special Master Commissioner.

Zebulon Parker,
vs.
William Hatfield.
} In Chancery.

This cause came on to be heard on the original, amended and supplemental bills of complainant, the answer of the defendant, the exhibits and testimony, the report of the Special Master herein, and the exceptions thereto; and was argued by counsel. Whereupon the Court, on consideration of the premises, *do find;*—That the said complainant, and the said Austin Parker, deceased, were the original in-

ventors of the said several improvements in said bills mentioned and described. The Court do further find, that letters patent have duly issued from the United States, as set forth in said bills, and that all the rights and exclusive privileges secured thereby have become vested solely in the said complainant. The Court do further find, that the said several improvements, to wit: –1, The application of two, four, six, or more reaction wheels, of iron or wood, on one horizontal shaft, for saw mills and other purposes;—2, The principle of introducing water into reaction wheels, with a vertical or circular motion, by concentric cylinders enclosing the shaft, or other means;—3, The application of air-tight cases, or boxes, denominated drafts, as enclosures of reaction wheels, as described in the schedule of one of said letters patent, and mentioned in said supplemental bill, are new and useful improvements in the application of hydraulic power. The Court do further find that the letters patent of the defendant set forth in his answer herein, embrace no new or useful improvement, and are therefore *void;* and that the said defendant, in making, using, and vending his supposed improvements, is infringing the rights and exclusive privileges of the said complainant.

It is therefore ordered, adjudged, and decreed by the Court here, that the report of the said Special Master herein be, and the same is hereby, approved and confirmed, and the exceptions thereto be, and the same are hereby, overruled. It is further adjudged and decreed that the several letters patent of the said complainant are good and valid in law, and secure to the said complainant the exclusive right and privilege of making, using, and vending the improvements aforesaid. The Court do further adjudge and decree that the said defendant be, and he is hereby, enjoined from further making, using or vending reaction water wheels to be used in the manner of those heretofore made by him, or any other way infringing the exclusive privileges aforesaid of the said complainant during the time limited in said several letters patent of the said complainant for his use. And it is further ordered, adjudged, and decreed that the said defendant, within twenty days from the rising of this Court, pay the costs of this suit, and in default thereof that execution issue as in cases at law.

(July 24, 1846.)

SPECIFICATIONS OF ENGLISH PATENTS.

Specification of a Patent granted to Rees Davies, *of the county of Brecon, for improvements in the manufacture of Iron.* [Sealed 24th June, 1844.]

This invention consists in so conducting the process of manufacturing iron, when anthracite, stone-coal, or culm is used, that the charge may be caused to enter the blast furnace in an ignited state.

Fig. 1, is a vertical section of a blast-furnace, suitably constructed for carrying out this invention; fig, 2 is a horizontal section, taken on the line 1, 2, of fig. 1; fig. 3, is a vertical section of the furnace,

taken in the direction of the dotted line 3, 4, (fig. 2.); and fig. 4 is a horizontal section, on the line 5, 6, of figs. 1, and 3. *a*, is the part of the furnace in which the blast operates; this part is constructed in a similar manner to the ordinary blast-furnaces from the lower parts up to the boshes, and the blast (whether hot or cold) is applied in the usual way by the tuyeres *b*, *b*. Above the part *a*, the interior of the furnace is contracted, and forms a chimney *c*, to carry off the gases and products of combustion; the charging of the furnace is not effected through the tunnel-head or chimney *c*, but through the passages *d*, *d*, excepting the first charge, which must be made with unignited materials, in the ordinary way. *e*, *e*, are kilns or chambers, into which the charges of iron ore, fuel and flux, are continually introduced and ignited; the upper ends of the chamber are open, to receive the successive portions of the charge, and the lower ends communicate with the furnace *a*, by the passages *d*. *f*, *f*, are openings for stirring the charge and regulating the passage of the descending materials from the chambers *e*, into the furnace. The blast does not act on the charge contained in the chambers *e*; but the anthracite being kept in a state of partial combustion, by the draft of atmospheric air through it from the passages *d*, there will be a previous ignition of the charge going on in the chambers *e*; this is important, as anthracite, stone coal, or culm, which has been ignited before being brought into contact with a blast of air, works more favorably in the manufacture of iron (either with hot or cold blast) than when thrown in a cold state into the blast-furnace; and the ore, after the above process, is in a more suitable state for introduction into the blast-furnace.

Fig. 1.

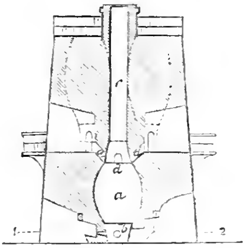


Fig. 3.

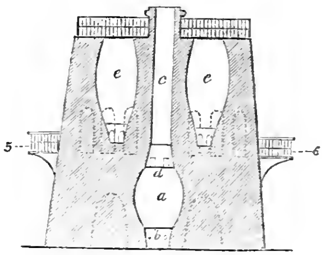


Fig. 2.

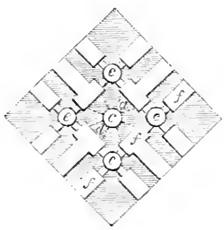
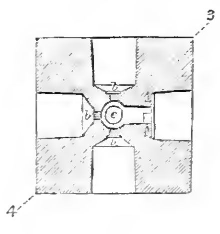


Fig. 4.



The patentee remarks, that although he believes it to be best to use anthracite, stone coal, or culm alone, yet other fuel may be mixed therewith; and that although he has shown the best arrangement of

furnace that he is acquainted with, he does not confine himself thereto, so long as the charge can be supplied to a blast furnace in an ignited state.

He claims the manufacture of iron by means of anthracite, stone coal, or culm (whether used alone or mixed with other fuel), which has been, together with the iron-stone or ore and flux, before its projection into the blast-furnace, brought into a state of ignition by a draft of atmospheric air, in chambers so arranged as not to interfere with the blast-furnace.—*Inrolled December*, 1844.

Lon. Jour of Arts & Sci.

Specification of a Patent granted to FREDERICK BANKART, *of the county of Surrey, for certain improvements in treating certain Metallic Ores, and refining the Products therefrom.*—Sealed August 7, 1845.

To all to whom these presents shall come, &c., &c.—My invention relates to and includes all metallic ores containing copper, whether in combination with sulphur or not in combination with it, and has for its object to convert the copper into a soluble sulphate of its oxide, and separating it from the foreign admixtures which the ores contain, to obtain it in the refined metallic state, and consists in adjusting and mixing together the different ores before mentioned, in such manner that those ores which hold sulphur in excess may compensate those which are wholly or partially deficient in sulphur; and in submitting the ores, so adjusted and mixed, to successive roastings and lixiviations, whereby a solution of sulphate of copper is obtained, from which the copper may be precipitated in a refined metallic state. And in order that my invention and the means of carrying it into effect may be fully understood, and before proceeding to the description hereinafter contained, I would premise that copper ores, as commonly known, are either sulphurets, oxides, or carbonates, or a mixture of all or some of the above in various proportions; they are also frequently mixed with bisulphuret of iron, or iron pyrites, and sometimes with the sulphurets of zinc and lead, and other foreign ingredients.

The oxides and carbonates contain, respectively, oxygen and carbonic acid, but no sulphur; bisulphuret of iron, or iron pyrites, contains iron and sulphur, and is frequently associated with and forms great part of the sulphur ores of copper, and in the processes hereinafter described, furnishes the sulphur in which the copper sulphurets as well as the oxides and carbonates of copper are deficient; for the conversion of their copper into sulphate and to allow for waste, and for the sake of convenience, I call the sulphur contained in the bisulphuret of iron or iron pyrites, whether naturally combined in the ores of copper or artificially mixed therewith in similar proportions, "sulphur in excess," as existing in a greater proportion than is required to convert the copper contained in the ore into a soluble sulphate of copper. It is well known that no copper ore, except the

copper pyrites or double sulphuret of copper and iron, contain alone sufficient sulphur for the conversion of their copper (when oxidized) into sulphates, whilst the oxides and carbonates do not contain any sulphur. And practically, much of the sulphur which copper ores actually contain, escapes in the form of vapor of sulphur, or sulphurous acid gas and sulphuric acid, and which requires to be replaced from other sources. The sulphur thus deficient is to be supplied by the bisulphuret of iron, or iron pyrites, either naturally associated with the ores of copper, as copper pyrites, or by artificial mixture, previous to putting them into the furnace.

I now proceed to describe the method I use for carrying my invention into effect. I take copper bars, usually sampled and sold, and if not already reduced to powder, I pulverize it, and although this is not absolutely essential, yet upon the greater or less completeness of this operation, depends very much the amount of fuel, labor, and time expended in the various processes hereinafter described. If the character of the ore, with respect to the relative proportions of copper and sulphur, having been ascertained, by analysis of the sulphur, bears a less proportion to the copper than one to two, I add iron pyrites, or copper pyrites, also pulverized, in such quantities as will raise the proportion of the sulphur to the copper in the mixture, to at least that above stated, namely, one to two. If two or more descriptions of copper ores are to be treated as sulphurets, oxides, carbonates or other natural combinations of copper, they are to be mixed together in such proportions as will make the sulphur of the mixture bear to the copper of the mixture at least the proportion of one to two, adding iron or copper pyrites, as before stated, where necessary to ensure at least that proportion of sulphur to copper; and I would observe, that care must always be taken to have a sufficient quantity of sulphur ores for the conversion of the copper into a soluble sulphate of its oxide, and also to allow for the escape of part of the sulphur during the processes, either as vapor of sulphur, or sulphurous acid, or sulphuric acid. The copper ore, prepared and adjusted in the manner before mentioned, is then to be submitted to such a degree of heat, in free contact with atmospheric air, as will oxidize the metals not already in a state of oxide, and convert the sulphur into sulphuric acid. For this purpose I place the ore, or mixtures of ores, in a common reverberatory furnace, and I submit the ore to a dull red heat, in free contact with the atmospheric air, until the mixture attains a state of seeming fluidity, which I find to be most favorable for the decomposition of the ores, and for the conversion of the copper into a sulphate, and I retain the mixture in that state until the evolution of sulphurous vapor nearly ceases. Instead of laying the mixture on the sole floor, or hearth of the furnace, at once, in a bed of from three to four inches in thickness, I prefer, in order to the more speedy accomplishment of the object in view, to divide the mixture into several portions, and having put one portion into the furnace, I add another portion when the first has attained a dull red heat, and the metals are becoming partially oxidized, and I keep repeating these additions, under similar circumstances, until the whole of the ore is put into the furnace,

and I find that by this mode the furnace is neither clogged nor injuriously cooled, and the ore is more rapidly decomposed than when all is put into the furnace at once; whilst the sulphur of the latter portions of ore, from their coming into intermediate contact with the partially oxidized metals, is more readily, and with less waste, converted into sulphuric acid, which, finding oxide of copper ready formed in the first portions of ore, unites with it and forms sulphate of copper. The mixture is frequently stirred, so as to expose fresh surfaces to the atmospheric air for the absorption of oxygen. In this first roasting a part only of the copper is converted into a sulphate, and the remainder, which was not already so, into an oxide; but by repeating the process of roasting the residue mixture, in conjunction with fresh sulphur ore, in the proportions before mentioned for the first roasting, and also hereinafter described, and which may be either before or after lixiviation next described, this remaining oxide of copper will be converted into a sulphate; but I prefer to wash the one after each roasting, in order that a part of the copper may be in a course of precipitation, whilst the remainder is undergoing decomposition in the furnace, as by this means a saving of time is effected.

The evolution of sulphurous vapor having ceased, or nearly so, I remove the mixture from the furnace to an adjoining vat or pit, and apply to it water (or a weak sulphate liquor from a previous lixiviation), of about the boiling temperature, and I retain it at that temperature some little time by means of injected steam, the better to ensure the solution of the sulphate of copper; and, having drawn off the sulphate of copper liquor from the residuum mixture, which I call "insoluble residue," I set the latter aside in readiness for subsequent use, previously drying it, or not, as may be convenient. I next assay this insoluble residue, and determine by analysis the quantity of copper and of sulphur (if any remain unacidified); and I then add iron pyrites, or copper pyrites, in such quantity as will make the quantity of sulphur contained in the mixture at least equal to half the quantity of copper therein. I then return this mixture so adjusted into the furnace, and subject it to a second process of roasting, conducted in a similar manner to the one already described, and continued as before until the sulphurous vapor has ceased to be evolved, or nearly so, and the mixture is then subjected to a second lixiviation, conducted as before described. I repeat this process of adjusting the mixture, roasting, and lixiviation, as hereinbefore described, with the successive residuums, once, twice, or oftener, according to the character of ores under operation; some yielding the whole of their copper to two operations, whilst others may require three or more before the copper is entirely separated. And in the second and subsequent furnace treatments, if the fresh sulphur ore to be used be copper pyrites, and is not already in powder, I prefer to use it in small lumps, by which means I obtain the sulphur more gradually, and make it available with less waste for the formation of sulphate of copper with the smallest residuum; and these lumps being afterwards separated by means of a sieve, and pulverized, are used to charge the furnace afresh. And when the copper ore is all in powder, iron py-

rites should be used for the last roasting, so as to avoid a remainder of copper. The next process is, to precipitate the copper from its sulphate solution, after which it is to be fused, and run into moulds, when it is ready for use or sale, as fine metallic copper. Various known modes of precipitation may be adopted; but I precipitate by means of iron, either cast or wrought metal, which I prefer to be in plates, presenting a larger surface to the action of the liquid, always keeping the solution at a temperature of from about 120° to 150° of Fahrenheit's scale, and as nearly as may be of the same strength, by means of a circulating stream of fresh sulphate solution, which, entering towards the top, and conducted through a pipe downwards, tends to displace by its greater specific gravity the lighter liquid or sulphate of iron, which overflowing is to be returned into the lixiviating vat to be re-charged with sulphate of copper, and this again precipitated, until the refuse liquid becomes a nearly saturated solution of sulphate of iron, when it is set aside to crystalize. The two conditions of high temperature in the sulphate solution, and the maintenance of a fresh circulating stream in the vat, contribute to the rapidity of precipitation, and to preventing the free acid of the sulphate solution from attacking and dissolving the iron beyond its corresponding or proportionate weight of copper precipitated. The sulphurous acid vapors, proceeding from the various roasting processes, hereinbefore described, may, if desired, be condensed either as sulphurous acid, or employed for the manufacture of sulphuric acid, according to various well-known methods.

Having described the nature of my invention, and the method of carrying it into effect, I would remark, that variations may be made in some of the arrangements and details without departing from my invention, so long as the general principle of it is retained. And I would also remark, that although my invention depends on the decomposition of the sulphuret of copper, and the formation of a soluble sulphate of the oxide of copper, I do not claim to be the discoverer of such decomposition, or of the formation of such soluble sulphate. I do not, therefore, claim as my invention the principle of decomposing sulphuret of copper ores, and forming a sulphate of copper, which has been long known; nor do I claim the obtaining a soluble sulphate of copper from copper ores; neither do I claim as my invention the precipitation of metallic copper from a sulphate solution; nor do I claim the furnace hereinbefore referred to, except so far as the same may be used for the purposes of my invention. But what I claim is, the mixing of the different ores of copper and iron pyrites in due proportion, according to the quantity of sulphur relatively with copper which they respectively contain, and adjusting them in such manner as, that those ores which hold sulphur in excess may compensate others which are wholly or partially deficient in sulphur, and in subjecting such mixture to a succession of roastings and lixiviations (the residuum after each roasting having the proportion of copper to sulphur adjusted as before), and thereby obtaining a solution of sulphate of copper, whence the copper is obtained by precipitation in a refined metallic state.

Enrolled February 7, 1816. Rep. Pat. Inv.

Specification of a Patent granted to William Bedington, *junior, of Birmingham, in the county of Warwick, for improvements in the Construction of Furnaces.*—Sealed July 10, 1844.

The invention consists of a mode of constructing furnaces so that the same may burn the fuel more advantageously, and the evolving of much dark, dense smoke from the chimneys prevented.

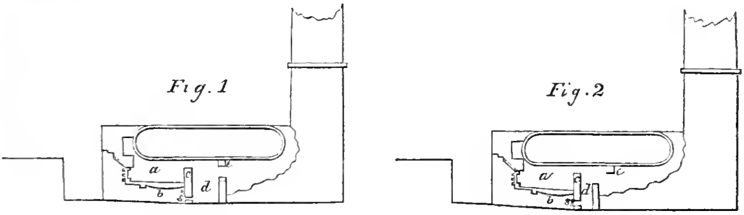


Figure 1, shows a section of a steam-boiler furnace arranged according to my invention.

Figure 2, shows a section of another arrangement of furnace, differing simply in the placing of the hanging bridge. *a*, is the furnace, which is of an ordinary construction, and may be varied in size, and also in arrangement, without departing from the invention. *b*, is the ash-pit, at the back of which, and behind the bridge, *c*, there is a chamber, *d*, into which a supply of atmospheric air is kept up, in order that the said air, rising upwards, may mix with the products passing from the furnace, and thus inflame them, there being suitable means for regulating the supply of air into the chamber, *d*, which may be accomplished by a valve, as shown at *s*, or a slide, or other convenient means, so that the person attending the fire may prevent too much air passing into the chamber, *d*, and yet that the supply shall be sufficient for causing the products coming from the furnace to be inflamed; but having once regulated the size of the opening, so that the furnace works well, I have not found it necessary afterwards to alter the opening for supplying of air.

I would here remark, that I am aware that various means have before been resorted to for supplying atmospheric air at the back of the bridges of furnaces, so as to cause the products passing beyond the bridges to be inflamed, and I therefore do not claim the introduction of atmospheric air at the backs of bridges, nor the making a chamber, *d*, behind the bridge of a furnace when separately considered; but *e*, is a hanging-bridge, by which the products, in their passage away, are caused to be deflected, and this aids the mixing of the products passing from the furnace with the atmospheric air rising out of the chamber, *d*. And though, with respect to the use of hanging-bridges, such as is shown at *e*, in Figures 1, and 2, I make no claim thereto in their separate form, as similar hanging-bridges have before been used, yet, combined with the use of a chamber, such as *d*, from which a supply of atmospheric air may be supplied to the passing products, in order to their being inflamed, I consider these hanging-bridges new.

In fig. 1, the hanging-bridge is placed over the chamber, *d,* whilst that in fig. 2, is shown just beyond the chamber, *d,* and I have introduced these two arrangements in order to sbow that the position of the hanging bridge may be varied. And it will be evident, that although I have only shown a steam-boiler furnace, other furnaces, for other purposes, will be readily made by a workman from the description herein given, the arranging chambers, *d,* at the back of the bridges *c,* and combining therewith the use of hanging-bridges, as herein explained.

Having thus described the nature of my invention, and the best means I am acquainted with for performing the same, I would have it understood, that what I claim, is the so constructing or arranging furnaces for steam-boilers, and other purposes, as to combine the use of chambers, *d,* and hanging-bridges, *e,* beyond the bridges, *c,* as herein described.

Enrolled January 10, 1845. Rep. Pat. Inv.

MECHANICS, PHYSICS, AND CHEMISTRY.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Description of the Iron Steamer "John Stevens."

WITH A PLATE.

The following detailed description of the splendid iron steamboat "John Stevens," which is now running between Philadelphia and Bristol, in connexion with the railroad line to New York, has been furnished to the Journal at our request. Com. Pub.

The Boat was built for the Camden and Amboy Railroad Company, and is the first boat, of the largest class, built in this country of iron. Her hull is made of the best quality of Pennsylvania plate and rib iron—the plate iron being $\frac{1}{4}$ inch thick and the rib iron of the angle form with this difference, from the common angle iron, that there is more iron on the top edge and less in the body, just the contrary to the common form. The ribs are placed two feet apart from centre to centre except immediately under the engine, where they are one foot apart, the size of the ribs, is $3\frac{1}{2}$ by $2\frac{1}{4}$ inches, the weight $7\frac{1}{2}$ lbs per lineal foot—she has four kelsons of $\frac{1}{2}$ inch iron with angle iron riveted on top edge; they are three feet deep—two of which stand 12 feet apart, and are 164 feet long, the ends tapering for the length of 46 feet down to 12 inches in depth, upon which the boilers rest, which stand 41 feet 6 inches apart fore and aft—the other two kelsons are those upon which the engine rests, being 72 feet long and 3 feet deep, in the centre, for the distance of 24 feet, the balance being reduced to 12 inches in depth. These kelsons are all fastened to one another, and sides of boat, by cross kelsons, 3 feet deep and of a distance varying from 3 to 10 feet—she is also provided with a water-tight bulkhead of iron 27 feet from the bows which is a great safety to passen-

gers in case of the bows being stove in, which often happens, with great loss of life and property.

Being intended for a day boat and not having been fitted up with berths, her cabins and saloons are very airy, light, and roomy. The main cabin below is 60 feet long and 28 feet wide, with 8 windows on each side, 2 feet by 20 inches wide. The forward cabin below is 40 feet long and 28 feet wide, with 6 windows on each side, the two cabins being connected by a passage way 9 feet wide, and lighted by means of sky lights. The saloon on the main deck, is 60 feet long and 30 feet wide. The space enclosed on the main deck in front of the saloon, is 85 feet long and 31 feet wide. The upper saloon is 70 feet long and 30 feet wide. There is also, below, a cabin for emigrants, 25 feet long and 20 feet wide, and a forecastle for the crew. They are fitted up in the most complete manner with every regard paid to comfort as well as elegance. The cabins are furnished in white and gold and a large portion of the furniture is rosewood covered with plush.

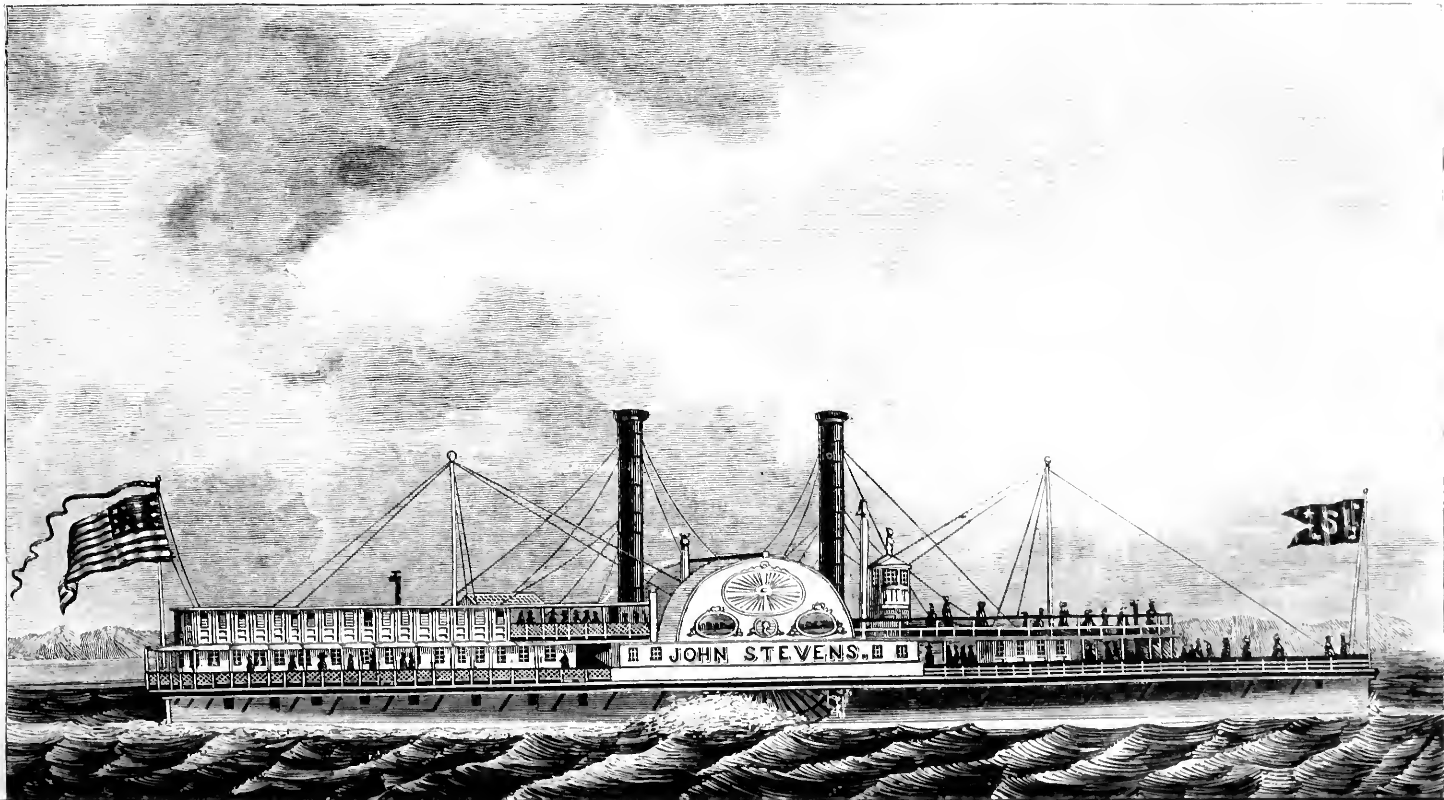
	ft.	in.
Length on deck, .	245	
Breadth of beam, . .	31	
" over all, .	65	
Depth of hold, .	11	
Diameter of water wheels, .	31	8
Face of " " .	12	
Dip of " " .	2	7
Tonnage, . .	800	tons.

Draught of water—completely ready for passengers with boilers filled and carrying, in iron tanks constructed for the purpose, and placed under the forward and after cabin floors, a sufficient quantity of fresh water, to feed the boilers for a four hours run, and also carrying fuel for the same length of time—5 feet. Her engine is of that kind, known as the steeple engine, improved by the addition of double connecting rods, with vibrating cross head, which passes through main cross head and works upon guides, by balance valves fitted with expansion gear to cut off the steam at from $\frac{1}{4}$ to $\frac{2}{3}$ of the stroke of the piston, and also by an improvement in the air pump bucket, which has a circular double opening valve. The engine was made by Messrs. T. F. Secor & Co., of New York, and is a most beautiful and substantial piece of work, constructed entirely of iron with an accuracy and neatness of finish unsurpassed in this or any other country.

	ft.	in.
Diameter of cylinder, . .		75
Stroke of piston, .	8	
Diameter of air pump, .		31
Stroke of " .	8	
Diameter of force pumps, .		$3\frac{1}{2}$

Stroke of force pumps 8 feet, which are worked from the air pump cross head, one at each end—air pump cross head passes through one end of main cross head, and also works upon a set of guides at each end. Boilers of a tubular construction, placed fore and aft of engine being 15 feet long by 12 feet wide, each having 384 tubes, 12 feet

long and 1¾ inches bore. The furnace of each is 7 feet long by 11 feet 4 inches wide, the flame returning through the tubes, af-after having passed under the boiler. The boilers and coal boxes are below deck. The fires have an artificial draught from a circular fan 13 feet 6 inches in diameter, blowing into air-tight fire rooms, and worked by a small separate engine, of 16 inches cylinder and 14 inches stroke. The engine, when working with 30 lbs. of steam, cutting of at one half the stroke, and making 22 turns of the wheel, or 44 strokes of the piston, would, allowing 11 lbs. for vacuum in cylinder, and deducting 5 lbs. for friction, work to 1495 horse power. For further safety in case of leakage, she is provided with a bilge injection, of a capacity sufficient to supply the air pump, with as much water as it will lift, with the ordinary speed of the engine—also as a further security, against damage to the rudder, from ice or other floating substances, it is placed under the run of the vessel, the upper edge being 2 feet below the water line. Her speed is believed to be the greatest ever obtained by a steam boat, either in this or any other country. From trials continued for two days, made by running over a measured distance, of half a mile, made by placing ranges on Staten Island, near Fort Richmond, and directly opposite the ship channel, her time of going the distance, at different speeds, was accurately taken by two separate stop watches, and also with two revolving logs, which gave the speed exactly, as found by the stakes, agreeing within ¼ per cent of each other; and upon a further trial, in calm weather and deep water, it was found that the boat obtained a speed of 19 miles an hour, the engine at the time making 22 turns per minute, which is a greater speed than any authenticated record shows ever to have been performed. The posts for the ranges were set with a theodolite and still remain. The model of this boat was made by Robert L. Stevens, Esq., the draughts of the engine were also furnished by him. This being the sixth steam boat built by him at Hoboken, within the last 18 months, two of them being of the same size as this, and four built on an entirely different model, being built throughout with straight timbers. He also modeled the celebrated yacht Maria, belonging to the three brothers, Robert L., John C. and E. A. Stevens, which has been found to excel, in speed and accommodation anything of the class ever built—and we will farther mention that there are many improvements in the detail of the hull of the John Stevens, that have been introduced by Mr. R. L. Stevens, amongst which are the peculiar form of the rib iron, first introduced on her and since extensively used in England, and the arrangement of diagonal iron braces outside the hull above the water line. It may be mentioned as a proof of the accuracy with which the displacement of an iron boat can be calculated, that when completely finished, her draught of water agrees to ¼ of an inch with the estimate made before building. Her cost was a little upwards of $100,000.


JOHN STEVENS.

For the Journal of the Franklin Institute.

Fire-Proof Library.

Paterson, September 28, 1846.

To the Committee on Publications.

Gentlemen :—I can scarcely hope that so small a matter as my little fire proof building can interest you, but as you desired a description I proceed to comply with your request.

The building is intended to secure from fire a library which my wife inherited, and which, besides great pains, has cost a large sum of money. It is 24 feet by 18 feet outside, and 20 feet from foundation to the roof ceiling, giving 10 feet to each story, built entirely of brick, stone and iron, except the middle floor and 6 windows which are in front, and so much in advance of our other buildings as to be out of the reach of any danger. The ceilings are not yet plastered, as I want to see how the roof gets through the winter; but in every other respect the house is finished as I intended.

The walls are one foot through, and at four courses of brick above the ground, there is a strip of sheet lead placed all around the wall to prevent the attraction of moisture, so effectual is this remedy that the walls were perfectly dry two days after they were whitewashed.

The first floor is of stone 2½ inches thick by 4, and 6 feet square, the joints cemented with Roman cement.

The doors are two, which connect with a frame building and are of iron.

The second floor is 1¼ inch plank on 3 cast iron rafters, made in the form of a cross, each arm being 4 inches from the centre, and one inch thick. They were so cast as I intended to place them on a stone floor; but, apprehensive that a jar might break them, and endanger some one who might be underneath at the time, and not seeing any greater danger than there could be from the book cases surrounding and covering entirely the walls, I changed my purpose and put down plank.

The roof is of brick arches laid in Roman cement, plastered with the same outside, then washed with cement smoothly with a white washing brush. It is secure from fire, but I do not know how the frost may affect it, some tell me it will scale, others say it will answer very well for a number of years, if so, it is easily repaired and I shall be content. The arches are 2½ inches rise and 19 inches span, resting on cast iron beams alternating crosses as on the first floor, and T's 8 inches across the top and 4 inches in a vertical direction. The roof has an inclination of one foot in eighteen, and all the beams rest 7 inches on the walls. The walls are not seen, being covered with book cases and are therefore only white-washed. The cost of the whole is exactly as follows :—

39570 brick at $4	$158·2
20 barrels lime	20·0
40 loads sand	16·0
Amount over,	$19 4

	Amount brought forward,	$194·28
6360	lbs. cast iron, $3\frac{1}{2}$ cts.	222·60
$\frac{1}{2}$	barrel Roman cement	3·00
353	square feet stone	44·12
8	sills of stone	4·00
90	feet stone coping	12·50
	Sheet lead	11·00
	Mason work 18s. per 1000	90·00
	Whitewashing 2 days	2·00
	Stained glass windows	37·50
2	wrought iron doors	54·00
	Padlocks for same	2·50
5	windows	25·00
	Hinges and fastenings	10·00
	Wooden floor	10·50
	Carpenters laying	5·00
25	lbs. nails	1·00
	Window shutters and fastenings all trimmed	22·00
	Total cost	$751·00

If this be of any further use than merely to show how cheaply you can build in the country a thorough fire proof house, I shall be gratified to have it my power to present you a novelty.

Respectfully, JOHN TRAVERS.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On using Steam expansively.

TO THE COMMITTEE ON PUBLICATIONS:—

Under a similar title, in the Journal for September, Mr. Erskine Hazard has promulgated very erroneous doctrines on various subjects, some of which I am desirous of correcting.

There is no lack of tables, showing the ratio of effect produced by steam at full stroke, and cut off at any part of it; in fact, that is shown by every table of hyperbolic logarithms; nothing more being necessary, than to find the logarithm corresponding with the number of times the space, occupied by the full steam, is contained in that occupied by the same when expanded: Thus, if the space into which the full steam is admitted be 1, and that into which it is expanded be 2, it is said to be cut off at $\frac{1}{2}$stroke, and, the effect or gain produced by the expansion, is represented by the hyperbolic logarithm of 2, viz. .6931, to which 1 must be added, making the total effect 1.6931, and this being divided by the space into which the steam is expanded, viz. 2, gives the average effect throughout the whole stroke of the piston, viz.: .8465 as shown by the table of Mr. H— at page 191. By this table also it appears, that the same quantity of steam is nearly 18 times as effective, when used expansively and cut off at $\frac{1}{100}$ part of the stroke, as when used at full stroke.

And now let me refer to page 194, where Mr. H. says, that "steam at 180 lbs. pressure, cut off at $\frac{1}{100}$ of the stroke, by the table, will give

an average pressure of 10 lbs. to the whole cylinder, and, by adding the vacuum and air pump, 10 lbs. more may readily be obtained."

Now omitting any remark, further than noting, en passant, the oddness of the expression contained in the latter part of the sentence, it would appear that Mr. H. supposes, that steam may be worked to almost any extent expansively without a condenser; let me tell him however that in this he is entirely mistaken, and that instead of "such an engine" giving "a power equal to two of Boulton and Watt's, of the same size, worked with atmospheric steam," it would rather require them to make it work at all; the pressure of the steam being already 5 lbs. under the atmosphere, according to his own statement. If the 180 lbs. is so much above the atmosphere, that makes but 195 lbs. altogether, and the average pressure throughout the whole stroke, would not even then be 11 lbs.—"adding the air pump."

Hence steam cannot be used to advantage with any great extent of expansion without a condenser, for, steam at 75 lbs. above the atmosphere, cut off at $\frac{1}{6}$ of the stroke, has not power enough at the end of it, to expel the eduction steam through the valve, and the same would occur with steam at 165 lbs. if cut off at $\frac{1}{10}$ of the stroke.

In short, either with or without a condenser, the steam must never be expanded so far as to be unable to overcome the resistance opposed to it, which, practically, must include the element of friction.

To illustrate this part of the subject, in a popular manner, with sufficient accuracy for practical use and easy of remembrance as an empirical rule where tables are not accessible, we may suppose 10 steam cylinders, all of the same capacity, and calling the whole $10 = 10$, of course $1 = 1$, we will use one of them only at full steam, calling the effect produced $= 1$: Now, all that can be made of that steam after it has produced that effect, is clear gain, let us therefore pass it into the second cylinder, and take the pressure at the centre as the average pressure throughout, which although incorrect is sufficient for our purpose, this pressure will be 1 at the commencement of its being let in, and .5 at the end, but the point at which we propose to take the pres sure at, is, the centre between those two, where the steam has expand ed to $1\frac{1}{2}$ times, therefore $.666 = \frac{1}{1 \cdot 5}$ is the gain effected by using the second cylinder; if we go on and use a third we have $.4 = \frac{1}{2.5}$ as the gain by using that only, making the whole gain $= 1.066 = .666 + 4$ and the whole effect $2.066 = 1 + .666. + 4$, and so we may proceed, until we attain to those practical limits, beyond which it is a waste of power to proceed. When expanded 9 times, *i. e.* filling the 10 cylinders, the average pressure in the last is little more than $\frac{1}{10}$ that of the full steam, and the whole effect is 3.3026 by the table produced by 1 of full steam.

I will notice another error of Mr. H.—and I have done; it is, that "double pressure should contain a double quantity of water." He is led into this error by what he calls, but erroneously, a law of Dalton's, "that steam obeys the same law as the gases," &c., and no doubt

it does under the same circumstances: place steam, in point of temperature above, and of pressure below that of condensation, and out of contact with the liquid which forms it, and the law is correct. Boyle and M. de Sassure have proved that the absorption of water by gaseous bodies is directly as the pressure, so long as the temperature is the same, but when that varies, we must resort to a law discovered by Gay Lussac, Dulong and Petit, who have shown that gaseous bodies expand $\frac{1}{480}$ for each degree above 32° F. Now 100 cubic inches of gaseous vapor at 32° will weigh ·13716 grs. and its elasticity will be ·2 in. mercury, but if we increase the heat, we increase the elasticity also, and out of contact with water an increase of 180° of the former, will cause the latter to become ·275 in. $\left(= \cdot 2 \times 1\frac{180}{480}\right)$ at 212°. and as the elasticity and density of steam are in the same proportion so long as the temperature is the same (which is only re-stating in other words the law of Boyle and M. de Sassure) we have $14.9629 = \frac{30 \times \cdot 13716}{\cdot 275}$ or ·275 : 30 :: ·13716 : 14.9629 = the grs. of water in 100 cubic in. of steam at 212°, and 30 inches or 1 atmospheric pressure.

In calculating the following table, I have adopted the temperature, in accordance with the experiments of Dulong, Arago, and others of the Parisian Academy of Science, and the Rule 1. Multiply the pressure in inches of Mercury by 329.184 and divide by the temperature plus, 448° F., and the answer will be, the grains of water contained in 100 cubic inches of steam.

Temperature.	Pressure.		Weight of 100 In. of steam.
F.	in Atmospheres	in In. of Mercury	in Grs.
212°	1	30	14.9629
250.52	2	60	28.2755
275.18	3	90	40.9670
293.72	4	120	53.2574

Thus the increment of temperature, for each increasing atmosphere of pressure, decreases until at 24 At. only 3.78° additional temperature will be necessary to reduce the pressure to 25 At.

As an approximate rule, to find the temperature at which the pressure of steam will be doubled:

Rule 2. Multiply the temperature by 1.179 and the answer is the temperature at which the pressure will be doubled, nearly.

I must now close this long article, as I have already extended it beyond the limits I had fixed upon.

Yours respectfully,

THOMAS PROSSER, C. E.

New York, September 30th, 1846.

Manufacture of Large Achromatic Lenses.

Translated from the *Comptes Rendus* for the Journal of the Franklin Institute.

By the following extract from a recent French Journal, it will be perceived, that the present highly improved state of the glass manufacture in France, bids fair to enable the construction hereafter, without difficulty or excessive cost, of those large achromatic lenses, which, though a great desideratum in astronomy, have hitherto foiled the ablest opticians. COM. PUB.

Mr. Arago read (before the academy), some passages from a letter which Mr. Bontemps wrote to him, and by which this very able director of the glass works of Choisy-le-Roi offers to the bureau of longitudes, the masses of glass necessary for the projected execution of the large achromatic telescopes, for a price almost incredibly small. The following are the extracts:

"A disk of flint glass for a lens of 55 centimetres* aperture, weighs about 40 kilogrammes; I would estimate these 40 kilogrammes at 10 francs per kilogramme, this is nearly the price at which I sell the flint glass in plates for lenses from 3 to 7 centimetres aperture; these 40 kilogrammes at 10 francs, make . . . 400 francs.

40 kilogrammes at 10 francs, make . .	400	francs.
The expense of softening† will be about .	150	"
I will furnish, then, this disk of 55 centimetres, for	550	"

"A disk of the same kind has heretofore been worth 40,000 francs, when the fabrication was still in its infancy. We have sold a disk of 32 centimetres for 3,000 francs; and a disk of 38 centimetres for 5,000 francs.

The disk of crown glass, of 55 centimetres, will weigh about 25

kilogrammes, at 10 francs, .	250	francs
The softening will cost about	200	"
Total,	450	"

"The disk of flint glass, and the disk of crown glass, for the lenses of 55 centimetres aperture will cost, then, 1000 francs.

"A disk of flint glass of 1 metre‡ in diameter, will weigh about 150 kilogrammes, this will be, at the price of 10 francs 1500 francs

The cost of softening will be about	1000	"
Total,	2500	"

"The disk of crown glass will be about the same price.

"To construct a disk of this kind, I shall be obliged to make a furnace, and larger crucibles, but the operation having in fact the same degree of certainty, the cost of this furnace will be covered by the current sale of flint and crown glass.

"It should be indispensable, when we desire to make a lens of large dimensions, not to manufacture one disk solely; I will therefore place at the disposal of the bureau of longitudes, several disks of the diameter of the object glass which we desire to construct, and only that one which shall be acknowledged to be the best, shall be paid for to me; the remainder shall enter into the common consumption for optical purposes."

* 21 2-3 inches English measure nearly. †And moulding.—[Trans.
‡ 39.371 do. do. do. do.

Extract from the "Comptes Rendus" of the 13th May, 1844.

"Mr. Arago submitted to the academy, a project relative to the execution of a large astronomical telescope, a project which was conceived in consequence of the recent progress made by the French glassmakers, in the manufacture of flint and crown glass. The new instrument will have dimensions greatly superior to those of the telescopes which have been heretofore made—will require, on the part of the artist who shall be charged with its execution, the employment of new methods, which would doubtless be a subject of long and expensive experiments for him, if he were not directed by the advice of persons skilful in such matters. Mr. Arago proposed then to the academy, to form a committee immediately, to be taken from their body, to give instruction on this subject—Messrs. Biot, Arago, Gambey, Regnault, and Babinet, were appointed members of the committee."

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Description of the Process of Manufacturing Flint Glass and Crown Glass. By G. BONTEMPS, Director of the Glass-house of Choisy-le-Roi.

On the 27th January, 1840, I read, at the Academy of Sciences, a memoir on the manufacture of flint glass and crown glass; in that memoir, I gave a historical sketch of the attempts made, at different times, to produce flint-glass and crown glass suitable for optical purposes. P. L. Guinand, senior, of Brennets, in Switzerland, was the first who discovered a special process for that manufacture. After his death, I purchased from his son, the secret of the manufacture; I succeeded, in 1828, in manufacturing flint glass suitable for optical purposes, of which I presented specimens of a large size to the Academy of Sciences, in October, 1828. The most important part of the problem was solved, but I was also anxious to succeed in manufacturing crown glass that might be substituted in place of cast-glass, in the construction of the finer kinds of optical instruments; in my attempts, I met with very great difficulties, which I at length surmounted, and have manufactured crown glass equal in quality to flint glass; that is to say, free from striæ, from bubbles, from threads, and which does not attract moisture. After having made known all the *phases* of this manufacture, the details of all the difficulties which had to be overcome, I now propose to give the description of the process.

The invention of M. Guinand, Sr., consists in working and stirring the material while in a state of fusion, by means of a tool made of the same material as the crucible or glass-pot. He made a hollow cylinder of fire-clay of the same height as the crucible, closed at its lower extremity, open above, with a flat ledge all round of several centimetres in width. Having heated this cylinder red-hot, he placed it in the melted glass, then, by means of a long bar of iron, bent to a right angle at a distance of some centimetres from its extremity, which

he introduced into the cylinder of fire-clay, he worked and stirred the glass, by giving the bar a horizontal rotary motion.

For the manufacture of flint glass, and of crown glass, I have adopted a circular furnace, in the centre of which I place the crucible, or glass-pot, all the parts of which are exposed to the same temperature; and I have adopted the use of covered crucibles, because with crucibles of this form there is no danger of the glass being spoiled by particles of the fuel, or by drops, or tears *(larmes)* from the crown or arch of the furnace.

The success of the operation depends very much on the form and proportions of the furnace and crucible.

I will now give the details of a melting of flint glass, and of a melting of crown glass.

The figures represent the furnace, the crucible, the cylinder of fire-clay, the bent iron bar and its support.

Flint glass, of the usual density, similar to that used for table-sets, decanters, &c., is composed, ordinarily, of 300 parts of sand, of 200 parts of deutoxide of lead, and 100 parts of sub-carbonate of potash.

The density of this flint glass is from 3·1 to3·2.

The following composition, expressed in kilogrammes, gives the quantity necessary to fill the crucible: sand, 100 kil.; deutoxide of lead, 100 kil.; sub-carbonate of potash, 30 kil.

This composition gives a very white flint glass, of a density of from 3·5 to 3·6, and which is perfectly suitable for opticians.

It is scarcely requisite to insist on the necessity of purity in the raw materials, and the cleanliness to be observed in mixing them. It is not necessary to use either lime or arsenic, the only effect of which would be to diminish the whiteness of the material.

Details of the Operation for Flint Glass.—The crucible is to be heated in a special furnace kept for the purpose, and when at a white heat, it is to be introduced, in the usual manner, into the melting furnace, which has been brought to the same temperature; this operation cools the furnace and the crucible; the furnace must be re-heated in order to bring it to the highest possible temperature before introducing the materials *(enfourner;)* this takes about three hours; the throat of the crucible, which has been closed with two stoppers to prevent the entrance of smoke, is then opened, and about 10 kilogrammes introduced; one hour after, about 20 kilogrammes more, then, two hours after, 40 kilogrammes; each time the crucible must be re-closed with the greatest care, and nothing must be put in until the coal on the grate ceases to give out any smoke. At the end of from eight to ten hours, the whole of the composition will have been introduced; the crucible is left without being opened for about four hours; then the stoppers are removed for the purpose of introducing the cylinder of fire-clay, which has been heated separately to a white heat in the same furnace, and kept at that temperature until placed in the crucible; care is to be taken to keep it perfectly clean and free from ashes. At this period, the flint glass is melted, but it still contains bubbles; nevertheless, the bent iron bar is introduced into the cylinder, and the first stirring is given, which serves to coat the cylinder with glass,

(enverrer,) and to effect a more intimate mixture; at the end of about three minutes, the iron bar is white hot; it is taken out, and the ledge of the cylinder is placed on the edge of the crucible; this cylinder, being specifically lighter than the glass, floats slightly inclined, because its upper ledge is outside of the glass. The two stoppers are so replaced as not to push the ledge of the cylinder into the glass, and the stirring up of the fire *(tisage)* is recommenced. Five hours afterwards, a fresh stirring up with a single iron bar takes place, the glass is already well refined, and then from hour to hour there is a stirring, each time with a single iron bar; great care being taken that at each stirring there shall be no smoke in the furnace, and that the lower doors of the furnace are closed. After having thus used six iron bars, from 25 to 30 centimetres in thickness of coal is thrown on the grate, which forms a mass quickly reduced to coke, and which allows the furnace to cool, without exposing the grate uncovered. The various openings of the furnace are unclosed, the whole furnace and the crucible thus gradually and slowly cool; this operation tends to cause the bubbles which are not yet disengaged to rise to the surface. At the end of two hours this operation is finished, the furnace is again brought to the melting heat; after five hours of the highest temperature, the glass has resumed its greatest fluidity, the bubbles have disappeared, the grates are completely closed below, and the great *(brassage)* stirring commences, that is to say, as soon as one iron bar is hot, another is substituted for it, and so on, for about two hours. At the end of this time the material has acquired a certain consistence, the stirring is not executed without difficulty; then the last iron bar is taken out, the cylinder is removed from the crucible, which is very carefully closed, as well as the chimnies and openings, except a small hole of 2 centimetres, to permit the escape of the gas, which may have remained in the fuel. When the disengagement of gas ceases, the furnace is entirely closed, and it is suffered to cool, which takes about eight days; the door of the furnace is then removed, the crucible, with its contents, taken out, usually in a single mass, except some fragments which become detached round it; the only object now is to make use of this mass and these fragments, the mode of doing which we will explain directly, after having given the details of the operation for crown glass, which, as may be supposed, has a great analogy with the preceding.

Manufacture of Crown Glass.—After many experiments, I have found the following composition to be the best: white sand, 120 kil.; sub-carbonate of potash, 35 kil.; sub-carbonate of soda, 20 kil.; chalk, 15 kil.; arsenic, 1 kil.

The crucible having been placed in the furnace, as for flint glass, the introduction of all the materials is to be completed in about eight hours, four or five hours after which the cylinder is to be introduced, and the first stirring takes place; then, every two hours, a stirring with a single iron bar; six are to be executed in this way; the furnace is to cool very slowly for two hours, after which it is to be reheated for seven hours, this glass regaining its heat with much more difficulty than flint glass; the great stirring *(brassage)* then takes place,

which lasts about an hour and a quarter; the crucible, the chimnies, and the openings are to be closed, as for flint glass, and the whole is left to cool. Very commonly, as with flint glass, a mass and several fragments are obtained.

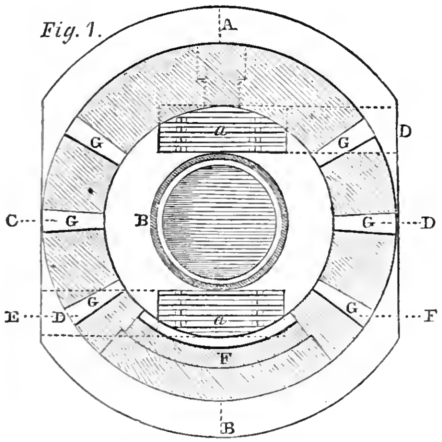
Parallel faces are made on the sides of the mass, whether of flint glass or crown glass, in order to examine the interior, and to see how it should be divided, for it is never free from striæ, which are usually found collected in one portion of it. After this examination, it is sawed into parallel slices, or transverse sections, in accordance with the observations made. Faces are also polished on the fragments, for the purpose of examining them, and disks are made of them in accordance with their weight; for this purpose, they are first heated in a furnace and then introduced into a muffle, where only the heat necessary to enable us to mould them is given. If the fragment is irregular, it is partially rounded by the nippers, and then, with other nippers, it is placed in a mould, under a lever press, which gives it the exact form of the mould, after which it is taken out with the nippers and carried to the annealing arch.

Explanation of the Plate.

Fig. 1. Horizontal projection of the furnace and crucible.

Fig. 2. Section along the line E F, fig. 1; that is to say, along the flue.

Fig. 1.



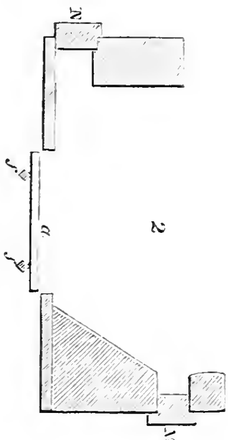


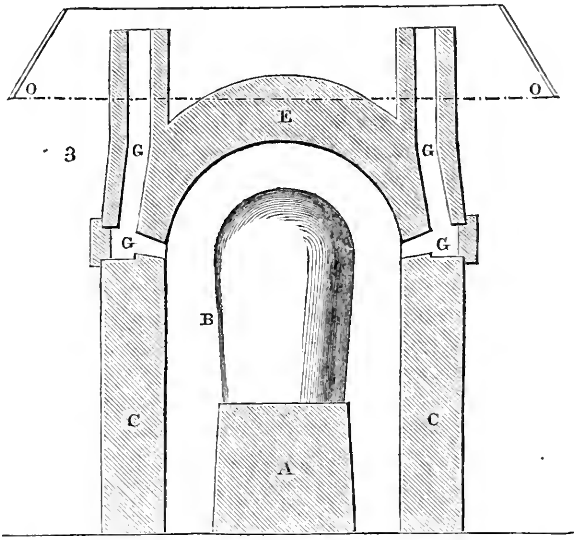
Fig. 3. Vertical section along the line C D of the plan.

Fig. 4. Vertical section along the line A B of the plan.

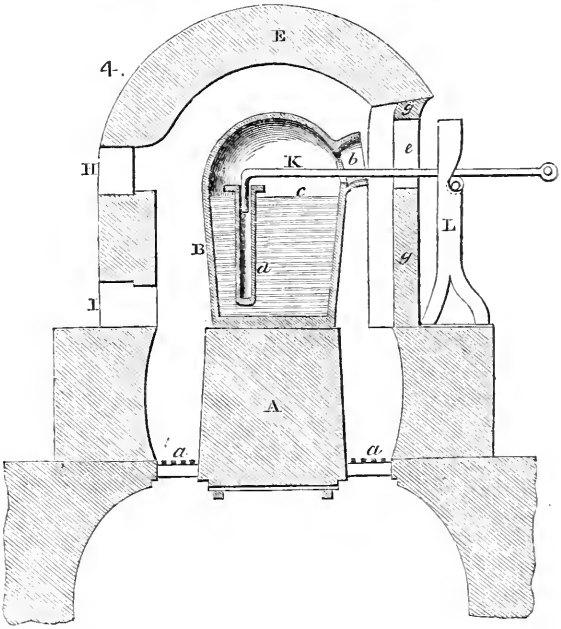
The same letters mark the same objects in all the figures. A, foundation or support of the covered crucible B. C, C, walls of the furnace. D, D, openings through which coal is thrown on the grate. E, arch or crown of the furnace. F, door or opening through which the crucible B is introduced and taken out; there is a small opening in this. G, G, G, six chimnies. H, an opening. I, hole to facilitate the placing the crucible on its support. K, bent iron bar, for working the

fire-clay cylinder. L, support, with a roller across, on which the bar K is supported. M, hole, with a stopper, through which the coal is thrown. N, hole, with a stopper, through which the grate is cleared.

3



4.



O, hood of sheet iron, under which the chimnies terminate. *a*, *a*, grate of the furnace. *b*, throat of the crucible. *c*, level of the melted glass. *d*, fire-clay cylinder for stirring. *e*, opening. *f*, *f*, bars supporting the grate. *g*, door of the opening *e*.

On the Diurnal Changes of the Aqueous portion of the Atmosphere, and their Effects on the Barometer. By Thomas Hopkins, Esq.

It is admitted by meteorologists, that the various quantities of aqueous vapor which exist in the atmosphere during the different hours of the day, contribute to the production of the variable atmospheric pressure, and the semi-diurnal fluctuations of the barometer. The vapor is, at a certain hour in the morning, at its minimum quantity, from which it increases during the day up to its maximum; after that it declines, and its variable pressure is exerted on the mercury of the barometer, and affects the height of the column. This takes place in a less or greater degree in all latitudes, though to the greatest extent near the equator.

The quantity of vapor existing in the atmosphere in each hour of the day is ascertained from the dew-point, or point of condensation; it having been found that each particular quantity of vapor diffused through the air has its separate dew-point. The dew-point is therefore taken as the measure of the quantity of aqueous matter existing in the atmosphere, and of the vapor pressure at every period of time. This pressure, thus ascertained, being deducted from the whole atmospheric pressure, furnishes the amount of the gaseous pressure, as given in our meteorological registers and tables.

But, is the dew-point a correct measure of the quantity of aqueous matter that passes into and remains in the atmosphere during the different times of the day? On the answer to this question it depends whether the hourly vapor and gaseous pressures on the barometer are, or are not, correctly given in our registers. If the dew-point be a true measure, then the pressure arising from aqueous matter may be taken to be such as is stated in those registers, and so far all the reasonings respecting the causes of the diurnal fluctuations of the barometer may be correct; but if the dew-point is a fallacious measure of that pressure, then the alleged facts may be unfounded, and the conclusions drawn from them erroneous.

There is reason to believe that in certain parts of the world, and for considerable periods of time, the dew-point may be a correct indicator of the pressure of aqueous matter, but in other parts it may not; and in order that we may trace this difference, in different times and places, we will inquire what are the relative quantities of vapor that hourly pass into the atmosphere, in some of those parts from which we have been furnished with accounts, and endeavor to learn whether those quantities are such to as to accord with the dew-points.

Kaemtz, a German meteorologist, in his Course of Meteorology, has furnished tables of the hourly vapòr pressure in different places, deduced, in the usual way, from the dew-point, and among them of that which is found to be the mean of the year at Appenrade, in Denmark, from seven in the morning to eleven in the evening. At seven, the pressure, in French measure, is 8 millimetres ·119, from which it

increases until one in the afternoon, when it reaches 9·511. From this time it diminishes, and at 11 P.M. is only 7·863.

The same writer has given the vapor pressure on the coasts of the Baltic, at Trapstow, near the Rya, for the months of July and August. It appears that in those parts the minimum pressure for July is 10·05 at two o'clock in the morning, and the maximum is 11·41 at two o'clock in the afternoon. For August, the minimum is 11·18 at three o'clock in the morning; and there are two risings, the first until ten o'clock, when it is at 12·05: from this time it falls till two, and then suddenly rises until three o'clock, from which time it falls for the rest of the day. From these statements, we find that there is, on the coasts of the Baltic, particularly in August, in the middle of the day, a material departure from a single rise and a single fall in the vapor pressure.

There are also tables for Zurich, and other places in its neighborhood. At Zurich, in the month of June, the minimum pressure is 10·56 at 4 A.M., from which hour it rises until 8 A.M. After this it falls a little, and irregularly fluctuates until 8 P.M., when it reaches 11·34, having fluctuated greatly during twelve hours, namely, from 8 A.M. to 8 P.M., and ranged 0·78.

In September, at the same place, the minimum was at 5 A.M., and there were two risings, with an intervening fall. The first rise was up to 12 o'clock,—four hours later than the first in June; and the advance above the minimum was 1·73, making a greater range than that of June by 0·95. Here, too, the disturbance in the middle of the day is very palpable. These parts of the world are at comparatively low levels,—the first named being near the sea, and the last (at Zurich) an inland situation, which, though considerably above the sea, is not on a mountain.

When these observations were made at Zurich, in the month of June, others were made on the adjoining mountain, called the Righi, 1402 metres above the Lake of Zurich. On the Righi, the minimum pressure was at 5 A.M., an hour later than that on the plain, being then 6·27, from which it rose until noon, and reached 7·54, making a range of 1·27. From this hour, the pressure declined until five the next morning.

On the Faulhorn, a mountain in the same locality, but higher than the Righi by 870 metres, observations were made in September, at the same time as others were made at Zurich; and on the mountain, the minimum pressure was 3·40, and occurred at 6 A.M., an hour later than at Zurich. From this time it rose until 3 in the afternoon, when it reached 5·07, making the range in the day so much as 1·67. It is thus shown that the range of vapor pressure was greatest, not where the temperature was the most raised, and where evaporation must have been the greatest, but in the latest and coolest month, and on the highest mountain! And in September, the pressure increased to the latest period of the day, not near the surface, the source of evaporation, but on the high mountain. These irregularities show that some cause was in operation, which determined the vapor that had been produced by evaporation from the surface of the earth in the warm

and comparatively dry month of June, to continue increasing at the low level up to eight in the evening, but to accumulate only to a moderate extent, whilst on the mountain it accumulated to a much greater extent, but not later than until noon. In the cooler month of September, however, the vapor accumulated to about an equal extent, and about the same times,on the low level and on the high mountain, presenting a great difference between the action of the vapor in June and in September. The absolute pressure of the vapor, it will be recollected, is greater in the lower than in the higher strata; but the increase of that pressure is greater in the higher part in the dry and warm month of June, while it is only equal in the moist and cool month of September, showing that it was not merely expansion and diffusion of the vapor produced by evaporation that were in operation, but that some other cause was at work, which made the vapor accumulate on the mountain more than on the plain in June, but not in September.

In high latitudes, the pressure of the vapor is the least in winter, and the most in summer. In Halle, in Prussian Saxony, for instance, it is 4·509 in January, and in July 11·626, almost three times the amount; and the same kind of difference between winter and summer is found in other northern parts. Generally it may be said to be the least in winter and in cold climates, and the most in summer and in warm climates.

When the dew-point, contiguous to the surface of the earth, is the nearest to the temperature, which is, say, at four or five in the morning, both the temperature and the dew-point are the lowest. From this time the temperature rises more than the dew-point, until the former reaches the highest point for the day. There is consequently in the lower part of the atmosphere an increasing difference occurring between the temperature and the dew-point up to the time of the highest temperature. But this does not take place in the same degree in the higher strata, as in them the dew-point progressively approximates to the temperature, until at some height the two become the same. In the forenoon, therefore, the lower air has its temperature removed progressively further from the dew-point, but when it ascends, it approaches the dew-point of the higher strata, until at last, at some height, condensation takes place, and cloud is formed. When this occurs, the vapor that is in the air below the cloud, being partially relieved from incumbent vapor pressure, ascends more freely from the lower to the higher regions, where the cloud is forming. Thus it is the rise of temperature near the surface that increases evaporation and raises the dew-point, and the vapor produced by this evaporation expands and forces its way upwards by its own laws of expansion and diffusion. But in ascending it cools by expansion 1° for, say, every 500 yards, whilst it has to pass through the gaseous atmosphere, a medium which is made colder by its own law of cooling, 5° for every 500 yards of elevation; therefore, as the vapor ascends, it must at some height reach a temperature low enough to condense a part of it and form cloud. On the formation of the cloud taking place, a part of the vapor that is in the atmosphere is converted into globules of

liquid, (water,) and the pressure of this condensed vapor on that immediately below it, nearly ceases: for these globules of water, unlike the vapor from which they have been formed, do not rest upon or float in the *vapor* atmosphere alone, but also on the *gaseous* portion of the atmosphere, which, from its superior quantity and density, will sustain the greater part of the weight of this floating water. The lower vapor, relieved from a portion of that which previously pressed on it, expands upwards more rapidly, and ascends sometimes so freely as to prevent such an accumulation as shall further raise the dew-point, although evaporation continues active below. Indeed the pressure from above may be so far removed by cloud formation, and the ascent of the vapor be rendered so free and rapid, as to lower the dew-point, as took place both at Zurich and on the coast of the Baltic. The processes which have been here described may be traced by attending at the same time to the dew-point and the heights of the ordinary and the wet-bulb thermometers. These are exhibited in the Plymouth registers and diagrams, presented to the British Association by Mr. S. Harris.

By reference to these it may be seen that at Plymouth the difference between the dry and wet-bulb thermometers is, at five in the morning, say about 1° of Fahrenheit. This difference increases until one in the afternoon, when it is, say, 4°; evaporation must therefore have gone on with increasing activity during this time; and at three o'clock, that is two hours after the time of highest temperature, the difference between the two thermometers is greater than it was at eleven o'clock, two hours before the highest temperature! Evaporation must therefore have been more energetic, and must have continued to throw into the atmosphere more vapor from eleven to three than it had done four hours earlier! Now, if increase of vapor pressure always accompanied increase of vapor, the increase of pressure at Plymouth must have continued up to three o'clock! If, however, we look at the curve or line of the dew-point, which represents vapor pressure in the diagram, we find that it did not rise after eleven o'clock, but continued stationary from that hour until 4 P.M.! It is therefore apparent, that at Plymouth the quantity of vapor which by evaporation passed into the atmosphere in the middle of the day, to add to the general atmospheric pressure, in some form, was not indicated by the dew-point. And analogy authorizes us to infer, that in other parts of the world, the state of the dew-point during the same portion of the day does not express the quantity of vapor that has passed into the atmosphere, and which must have added to its general pressure on the barometer.

In the Toronto registers, reported to the British Association at York in 1844, by Col. Sabine, the state of the wet-bulb thermometer is not given. But we may assume that, if it had been given, it would have shown the same features as those we have in the Plymouth registers and diagrams. In this report, it is, however, stated that Mr. Caldecott has transmitted to England five years of hourly observations with the wet and dry-bulb thermometers at Trevandrum, near Cape Comorin, where a large quantity of vapor generally exists in the atmosphere. It appears from these accounts that the minimum

and maximum pressures of the atmospheric vapor are there found to occur within three hours of each other,—the minimum coinciding with the coldest hour, 6 A.M., and the maximum occurring so early as at nine in the forenoon! Now, it is very desirable that it should be ascertained whether evaporation did or did not go on freely from the wet-bulb thermometer from six in the morning, not only until nine in the morning, but until two in the afternoon, the time of the highest temperature. Although the dew-point ceased to rise at nine, it is to be presumed, reasoning from analogy, that energetic evaporation continued through the middle of the day, and it probably was, (as at Plymouth,) more active between nine and two in the day, than it had been in any part of the time between six and nine in the morning. And the vapor which was thus produced at Trevandrum between nine and two, or still later in the day, may have ascended and formed cloud, which cloud must have added to the general weight of the atmosphere. Had we accounts of the state of the wet and dry-bulb thermometers, and of the dew-points at different heights, there is little room to doubt that we might trace the ascent of the vapor at Trevandrum until we found it collected and floating in the atmosphere as a cloud, and in that form adding to the general weight of the atmosphere.

Col. Sabine says that the maximum of vapor pressure occurring at Trevandrum at 9 A.M., may be a consequence of the sea-breeze blowing at that time. I have, however, shown that the daily sea-breeze is itself produced by the diurnal cloud formation; the sea-breeze is only another effect arising from the same cause. The sea-breeze blows towards the part, because the atmosphere has there been made lighter than in adjoining parts by the heating power of condensing vapor. The wind, too, that comes from the sea, particularly in the fine season, when the diurnal disturbance of the barometer is the greatest, comes more fully loaded with vapor after nine o'clock than was the air over the land before that time, and ought to increase the vapor pressure after that hour, instead of stopping the increase. If all the vapor that arose had to come from the same land surface of the locality, it might be supposed that evaporation could not continue to supply an adequate quantity to raise the dew-point after nine; but when the sea-breeze sets in, a current of air comes from an extensive sea surface, and brings with it the vapor which had been evaporated from that surface, not only up to nine o'clock, but until ten, twelve, or two o'clock, or still later: the tendency of the sea-breeze is therefore not to reduce, but to increase the supply of vapor. It may also be remarked, that whilst the maximum of vapor pressure is said to occur at Trevandrum at nine o'clock, the sea-breeze does not set in at Bombay until about eleven or half-past eleven. Supposing both these places affected alike by the sea-breeze, the cause of the stoppage of increase of vapor pressure, whatever that cause may be, must have been in operation two hours before the sea-breeze commenced blowing.

Formation of cloud is a cause sufficiently powerful in its operation to prevent the dew-point rising at Trevandrum after 9 A. M., as the

vapor produced after that hour may be equal only to that which is consumed in cloud formation; and we are authorized to conclude that it is to that formation we are to attribute the stoppage of the dew-point at Plymouth at eleven, and at Trevandrum at nine o'clock, instead of having it rising with the temperature during the hottest portion of the day in both places. And in the more northern or drier climates, if we do not always trace the same stoppage, it is to be attributed to the absence of daily cloud formation. In a very dry and cold climate, there is not in the course of the day sufficient water evaporated to produce a daily thick cloud, and therefore small vapor pressure goes on increasing with the temperature up to the hottest period. Under these circumstances, the vapor pressure, when exhibited in a diagram, forms a regular curve, having one rise and one fall in the twenty-four hours; but where much vapor exists, and much more is produced daily, the dew-point does not at all times indicate the pressure which results from evaporation, because the rise of the dew point is stopped at certain periods, not by a cessation of the production of vapor, but through its ascent in the atmosphere and conversion into a floating cloud. Boiling water in the open air does not rise above 212°, yet heat continues to pass into it from the fire that is under the water. The reason that the temperature of the water does not rise higher is, that as much heat passes from the water into the air as from the fire into the water. In like manner, evaporation of water may continue to throw vapor into the air without the quantity in the air increasing, because condensation may convert vapor into water as fast as evaporation furnishes it. But neither the fire nor the vapor is annihilated,—the fire passes into the atmosphere and the vapor becomes cloud, and we may trace both of them in their new state of existence, and mark the effects they produce.

Taking the period of a year, in all places the average daily march of the temperature shows a single rise from about six in the morning till one or two in the day; and evaporation, as shown by the wet-bulb thermometer, increases with the rise of temperature. If the whole weight of the vapor thus produced were to be registered and exhibited in the form of a curve, that curve would be the same in form as the curve of temperature, having one rise and one fall. But in the actual curve or line of the dew-point there is frequently found to be a fall where there should be a rise. At Zurich, and near the Baltic, the departure from the regular curve is considerable; in Plymouth, the line is level from eleven to four; and in Trevandrum, if a curve were formed, the line would cease to rise at nine o'clock, five hours before the hottest period! At Trevandrum the minimum and maximum of the dew-point occurred within three hours, whilst on the Faulhorn they were nine hours asunder; at Zurich, in June, they were sixteen hours asunder; and in other parts similar anomalies occur. These irregularities may be accounted for on the supposition that condensation of vapor produces them, because that process is very irregular in its action; but if this supposition is admitted to be true, it will follow that the dew-point is not a correct measure of the daily addition that is made to the weight of the atmosphere in the middle of the day by

the vapor that has been thrown into it, and therefore it does not present the means of ascertaining the separate gaseous pressure. For the same operation that keeps down the dew-point in the middle of the day, creates cloud that floats in and rests upon the whole mass of the atmosphere; and the gaseous portion of that atmosphere must then press on the surface of the earth, not only with its own weight, but with the additional weight of nearly the whole of the cloud that is then floating in it. And if the curve of gaseous pressure, as commonly given, does not show a rise resulting from this additional pressure, it is because the whole atmosphere is at the same time made lighter by the heat which has been liberated by condensation of vapor.

Lond., Ed. & Dub. Philos. Mag.

On the Proper Coal for Smelting Sulphuretted Lead and Silver Ores.

Sir,—Being in the neighborhood of a lead mine some short time ago, I was in company with a gentleman who gave a lecture on *galena*—the produce of the mine. I cannot give his ideas clothed in the eloquence of the lecture; but I feel my memory is not far erring in reporting the matter of the introductory part as follows. It amused me for its truth and quaintness. He commenced (taking from the table a lump of *lead-looking* galena) thus—"Gentlemen, I take into my hand what to all must appear to be a lump of lead: indeed, what else can it be? I have procured such before, and have experimented on it, and you shall hear the result of my experience. I placed it, in order to cast the same into a mould, over my fire, in a melting ladle, and patiently worked away, for a very considerable time, with the large kitchen bellows to make it flow; but to my great disappointment, I could not melt it. I considered the fire to have been a bad fire, and proceeded to make it anew; and a large and powerful fire I finally obtained; but yet my lead would not melt. What can the cause have been? I procured a small furnace, and succeeded in raising an intense heat; but even at this temperature my metal would not melt. At length I tested it in the powerful heat of a well-constructed reverberatory furnace; and, gentlemen, judge of my surprise—instead of melting into metal, as I expected, it ran into a dark-looking, dense mass of matter, no more like to lead than I am to a *brass candlestick*. As to temperature, I experimented on this in every possible degree, I verily believe; but, although I could soften it, I could not change it from its black, slag-looking state, and I never could succeed in separating any metal from it. Gentlemen (continued the lecturer with much energy), what is my enemy? Surely some evil thing mars my constant endeavors? What can it be? What is its nature, its habits, its wants? Can it be the vexatious interference of the Father of all Evil opposing me bodily? or has he here instead his *earthy representative*, SULPHUR? Indeed, it must be so. Gentlemen, how he *hug'd* his prey! How to cast out this *evil one* demands the very first attention. Fire won't do it: *no—he is too used to fire.* All the heat of

ten thousand times ten thousand of Nebuchadnezzar's burning fiery furnaces won't move him. He claws too tightly to be moved by fire; indeed; gentlemen, the greater the heat, the greater seemed the consolidation of the union of this evil one with my wished-for metal."

The effects of heat on sulphurous ores, as here described by the lecturer, certainly are correct. Heat alone, even the most intense, will not separate sulphur from lead, when in a close vessel; it will rather do mischief to your sulphurous ores, and render them less easily treated beneficially afterwards. These ores require to be carefully treated at a proper heat. But more than *mere heat* is necessary. *Oxygen gas* (atmospheric air) is also absolutely essential to effect the separation of the sulphur from the ore. Cold atmospheric air, admitted through your furnace doors, would in smelting be injurious. The oxygen of the air must be admitted of the same temperature as your furnace. The air must pass freely through the fire-chambers of your furnaces, and become of like temperature. A coal, therefore, to allow of this free passage of air, must possess peculiar properties, as hereafter explained. The coal necessary for treating such sulphurous ores as silvery galena must have these peculiar properties. It should be a coal highly charged with inflammable gas (hydrogen). It should, notwithstanding, have the property of a good coke. It should have high heating powers,—and should have the property also of *keeping itself light* in bulk during burning—that is, it must *not bind or cake*, like the best Newcastle household coals do. Every lump should keep for a long time (while even at a white heat,) its original form, like coke does—and thus keep a very *hollow* fire. Now, the effect of this hollow fire, and the lumps of coal being all independent of each other, like cannon balls in a tub, is, as you will readily understand, that, with the immense draft of the stack, a large quantity of oxygen is, with great facility, admitted between the red-hot independent lumps of coal, and heating the air to its own temperature,—and thus presenting itself in a very favorable state to act on our enemy, the sulphur. There are, of course, many difficult and interesting processes, besides the admission of air, to be performed before you can get the metal to flow; but we are now confined to the subject of coal only. In separating sulphur, *atmospheric air* at *high* temperatures is necessary,—and the way to obtain this is using a coal with the properties before mentioned; and even with this coal, the fire must be constantly attended to.

When the furnace is well heated, the fire must be lifted up to open it, as it were—and this more or less, according to circumstances—to allow a due quantity of air to pass through the burning mass. There requires much experience and judgment in managing this part of the process. The good smelter, indeed, should almost live in the ash-pit. He should put a woolen cap over his head and shoulders, and be ever keeping his eye on his fire, keeping it *duly* hollow (for it wants more or less of this according to circumstances); and it should be open, light, and clear, free from dust or dark, unburning coals; and a proper quantity of large clinkers should be placed on his fire-bars, to admit air freely. The fire-bars should never be allowed to burn any, for the

fire should at no time whatever touch them,—for large, well-burnt clinkers should be kept always on the top of them. This keeps the bottom of the fire hollow and open, and atmospheric air can then, with great facility, pass through them into the furnace. The bars themselves, at the beginning of smelting, are put in quite close together; and as the process goes on, and a good heat obtained, these bars are, one after the other, taken out more or less in number, as occasion seems to require. This removal of the fire-bars is for the freer admission of air, and gives room also for the furnace man to *hollow* up his fire, and keep it from choking. Now, a sticky, caking, Newcastle coal possesses all the evils that should be avoided in smelting works. The period of time, too, that the goods are in the furnaces, for this depends on the quality of the coal, is of the very first moment. When ready, not a moment should be lost; but the furnace at once tapped, and the metal and slag allowed to flow out. For with all care, lead, and so also silver, at a temperature lower than is generally supposed, will go off in vapor like steam from water. The quicker, therefore, the process, the better. The foregoing requisites—viz: carbon for the high temperature, inflammable gas (hydrogen), and which, perhaps, helps to reduce any oxide formed in the process,—and, above all, as positively one of the elements which are actually necessary, atmospheric air (or oxygen gas), to unite with the sulphur, and assist combustion—are all to be sought for in the furnace of the smelter. When longer than the usual time is required for flowing out your charge, in all probability the coals have been bad, and have not been *of the proper quality;* for will any coal furnish you with oxygen gas in quantity? In such delays, and from such causes, want of oxygen gas particularly, *the loss is often very great*, particularly in the continual volatilization of the metals—in the imperfect disulphurization of the ore—in the metals (even if separated) being suspended, like figs in a pudding, in the thick half-heated slag—and probably in much of the ore not metallized at all being mixed with, or suspended in, the imperfectly flowing slag. These evils arise from want of a higher temperature, and from a want of due admission of oxygen gas, which the bad coals would not allow to enter the furnace. *Bad* coal (that is, *bad* for smelting purposes) will keep the goods just in a midway state, between hot and cold—as it were, neither in the clouds nor on the earth—for a very considerable time. Such coals will, perhaps, run your ore into the state before mentioned, of a kind of black slag, by the sulphur not being discharged; and when once in this state the difficulty and expense in *extra* firing, *extra* fluxes, and *extra* heavy labor, &c. &c., are very considerable indeed, and the wear and tear of your furnaces much increased. The heat may have been great,—but the caking coals from their nature *not keeping apart*, with all the care of the furnace man, will not admit the very essential element—viz: atmospheric air—to freely pass onwards, and act on the ore. After the whole day's labor, and the time comes for flowing, on examining the produce you find the time and expenses have been all lost, and the *whole mass must go back into the furnace again for another term,* demanding greater care and expense than the first ill-fated attempt.

Now, although this kind of midway temperature will not flow your ores, with all your fluxes, yet it will do this very severe mischief—it will, notwithstanding its kind of neutral action, yet send perhaps half your metal into the air, never to be recovered again, and poisoning the whole of your neighborhood. Indeed, by continuing the use of such, you may volatilize nearly the whole of your metal away, to your very serious loss. Therefore, you see, it is no idle ignorance that demands a peculiar coal; but experience has taught the observant smelter that the best smelting coals are in the end the cheapest—indeed, more than one-third cheaper than any Newcastle coal at the usual price.

Now, as to the nature of the most desirable coal for smelting; it appears that anthracite or stone coal is nearly pure carbon, and free almost from hydrogen and bituminous matters—it is like in nature to wood charcoal. Now, it is evident that this coal would not do for smelting purposes—it affords no hydrogen, and no flame (or flare, as it may be called), which is required, both for heating the ore at a distance from the fire-chamber, and also for acting as a reducing agent besides,—carbon combined with hydrogen (carburetted hydrogen) not being afforded from it (stone coal) in sufficient quantity for the purpose of smelting. This coal is not a *caking coal*, and so far meets one of the requisites of a smelting coal. The Newcastle coal or bituminous coal, has all the necessary qualities as to *carburetted hydrogen* and *free burning*, that the other (the stone coal) is defective in; but it has the very great evil quality, of itself (as it were) *melting*. It becomes *soft*, and runs into masses, uniting itself together and capping, as it were, the top of the fire with an impenetrable cover. It continues very little time also in a solid form as coke and stone coal will do, but speedily burns away into a powder or ash; whereas the latter coal, the stone coal, will keep its form and figure, and therefore keep a hollow fire very much longer, and admit free passage to the atmospheric air through it, while the other coal will damp up the fire very quickly. A given quantity of stone coal will keep up, having once obtained a red heat, a greater heat for a much longer period of time than will a like quantity of bituminous or Newcastle coal. Neither the first nor the second quality, therefore, meets the wants of the silver-lead smelter. The first gives no flame, but will keep itself hollow—the second gives flame, but cakes into a mass. Neither will a mixture of the two answer the smelter's wants—no mixing together will answer the purposes required. You cannot form thereby a chemical combination—it can only be a mechanical one; and when a mixture of the two is thrown upon the top of a fire, the most bituminous part thereof will burn first, and the anthracite last. The same as if you well mixed together, in small shreds, some linen and worsted, and threw them upon a fire—your linen will be consumed before your worsted; and so with the above coals. At length you would have an anthracite collection only in your fire-chamber, if you used such a mixture; and, therefore, you do not obtain a desirable smelting fire. Now, if you could form a real chemical combination between these two coals, you probably would have a good smelting coal.

The art of man, I believe, has not effected this; however, *Nature*, it appears, has furnished such a combination. At any rate, she has produced a coal with all the requisites before mentioned, as being desirable in a good smelting coal. It is said that, in a coal basin or field, there is a gradual flowing, as it were, or chemical commixture, of one kind of coal into another—that, at one part of the coal basin, the highly bituminous quality shall be found, and at another part of the basin the pure anthracite coal shall make its appearance—in fact, that a very gradual change of quality is found as the two extremes slowly, as it were, approximate each other. If this be so, a good smelting coal could probably be found about that part of the basin which is equi-distant between the richly bituminous coal, and the stone-like anthracite: probably, the best would be found nearer to the anthracite than to the bituminous formation.

It has been said—" If you burn *twice* or *thrice* as many bituminous or Newcastle coals in smelting, it must be cheaper than buying coals (of the quality above described) from Wales." No greater error on the nature of the coal required, can exist; and for reasons, indeed, above but partially explained. The following may with propriety be added, from a recent report of Mr. Mangham :—" It may not be irrelevant to state, that the averages of ashes, charcoal, and volatile matter, of the several samples of the best coking Newcastle and Welsh coal are as follows :—

	Newcastle.	Welsh.
Carbon,	0·760	0·777
Ashes,	0·054	0·027
Volatile Matter.	0·186	0·196
	1·000	1·000

—" Heating power of Newcastle coal is 309, and heating power of Welsh is 312. Hence we see that the Welsh coal is superior to the Newcastle coal both for coke and gas."—J. M——s. *August* 11.

Min. Jour.

Suppression of the Smoke of Furnaces.

A report has been recently addressed to the Government, by Sir Henry De la Beche and Dr. Lyon Playfair, respecting the means and effects of preventing the smoke of furnaces. The following extracts will sufficiently explain the conclusions arrived at.

" The general principles upon which the combustion, or rather the prevention of smoke, may be effected are now well known, and admitted to be applicable in practice. Smoke consists of vapors produced by the partial combustion or distillation of coal, carrying up small particles of the fuel in mechanical suspension, and depositing, by the combustion of one of their constituents, carbonaceous matter in a fine state of division. The mode of preventing this smoke is to admit a sufficient quantity of air to effect the combustion of the carbonaceous matter, when the vapors are of a sufficiently elevated temperature to unite entirely with the oxygen of the air. If the tempera-

ture be not sufficiently elevated, the hydrogen of the vapors alone is consumed, and the carbon is separated in the fine state of division referred to. The gases produced by the complete combustion of fuel are colorless and invisible, and therefore do not come under the definition of the term smoke.

"As the prevention of smoke implies the complete combustion of fuel, the result, as an abstract statement, always is, that more heat is generated, and a saving of fuel effected, when it is so consumed as to prevent the emission of smoke; but although this theoretical conclusion is undoubtedly correct, the practical results are not always consonant with this statement.

"In consuming smoke in the usual way a quantity of cold air is introduced into the fire, and as this must be heated up to the temperature of the surrounding fuel, the loss of the latter may be equal to, or even greater than, the saving of the fuel from the combustion of the products of distillation. This often results in the careless use of furnaces constructed on the principle of smoke prevention, and thus leads to the contradictory statements given by those who have used such furnaces. But in all carefully conducted experiments the saving of fuel has been considerable, and the reason of this will be at once perceived, when it is considered that in addition to the combustion of the products of distillation there is a large amount of fuel saved by the combustion of a gas called carbonic oxide, formed by the proper product of combustion, carbonic acid, taking up, in its passage through the incandescent fuel, another portion of carbon, which escapes useless as regards the production of heat, unless burned by the air introduced at the bridge of the furnace, for the purpose of consuming the products of distillation.

"From these considerations, and from experiments conducted under our inspection, with a view to determine this point to our satisfaction, we arrive at the conclusion, that although from careless management of fires, there is often no saving, and that indeed there is frequently a loss of heat in the prevention of smoke, still that with careful management the prevention of smoke is in many cases attended with, and may in most cases be made to produce, an economy of fuel.

"It may be unnecessary to remind your lordship that the cause of the emission of smoke in manufactories may be classed under three different heads, the relative importance of which involves very different considerations in any attempt to legislate for its prevention. These are—1. The want of proper construction and adjustment between the fire-places and the boilers, and the disproportionate size of the latter to the amount of work which they are expected to perform;—2. The deficiency of draught, and improper construction of the flues leading to a chimney of inadequate height or capacity;—3. The carelessness of stoking and management by those entrusted with the charge of the fire-places and boilers."

It cannot for a moment be questioned, that the continued emission of smoke is an unnecessary consequence of the combustion of fuel, and that, as an abstract statement, it can be dispensed with. But your lordship will perceive that there are grave difficulties connected

with a general law to the effect that it shall be unlawful for chimnies, after a certain date, to emit smoke. With regard to steam-engines, the processes for the prevention of smoke have been matured, and in very many instances successfully employed. In this case, therefore, a law to that effect could be most easily and promptly carried out. In other cases mentioned in Lord Lincoln's letter, such as distilleries, dye-works, &c., the legislature has already granted powers in the Manchester Local Act; and as there are certain instances in which processes for the prevention of smoke have with them proved successful, it may be anticipated that the nuisance arising from these sources may be much abated, if they be subjected to the general law with that forbearance and caution which, under certain cases is so advisable. There are certain processes in glass-works, iron-furnaces, and potteries, in which it is neither possible nor desirable to apply a general law for the prevention of smoke; although the nuisance may be partially mitigated, by causing the steam engines employed in them to be so constructed as not to emit smoke. It is useless to expect, in the present state of our knowledge, that any law can be practically applied to the fire-places of common houses, which, in a large town like London, contribute very materially to the pollution of the atmosphere; but it may confidently be expected, that by a wise administration of a legislative enactment, carefully framed, a great progressive diminution of the smoke of large manufacturing towns will be effected, and that the most happy results will thus flow from this improvement, in the increased health and moral feeling of their population, the intimate connexion of which with facilities for cleanliness has been so often pointed out.

Civ. Eng. and Arch. Jour.

Paris Royal School of Mining.

The *Moniteur* publishes the usual ordinance, comprising the regulations of admission to the Royal School of Mining in Paris. It does not state that candidates for admission must be French, though they must speak the French language; and therefore there is no doubt that foreigners would be readily admitted, if found properly qualified. In the school the very best education that can be given is afforded to those who propose to devote themselves to mining pursuits, and to this education is united the advantage of practical instruction. The school is directed by mining engineers of the highest eminence, and by scientific men of the greatest learning. As there is no such institution in England, young men preparing themselves for the superintendence of mines, would do well, if possible, to avail themselves of the advantages of this school; and fathers of families destining their children for the mining career, could not possibly do better than send them to Paris.

At the recent examinations at this institution, Mr. J. Arthur Phillips, of Cornwall, stood first in mineralogy, metallurgy, and theoretical and practical chemistry.

Min. Jour.

Improvements in Alkali Manufacture.

Mr. Bell, of the Alkali Works, South Shields, has obtained a patent for condensing the muriatic acid evolved in the manufacture of sulphate of soda, and for condensing the acid fumes or vapors which arise in the manufacture of sulphuric acid. For the first method, the patentee employs several pipes or tubes placed vertically—say, four —about 20 ft. high, and 6 ft. in diameter; these cylinders are filled with coke, in pieces about the size of a walnut, and water is allowed to flow in small streams through the coke; they are so arranged that the acid vapors will ascend through one, and descend through the next, alternately—and with these is combined a peculiar means of obtaining a draught through the condensers; this is done by making the flue from the last terminate in a cone, and a jet of steam applied just below the orifice. To prevent any escape of deleterious vapor into the atmosphere, a close cistern is placed around the condensers, having one or more partitions descending from the top, and dipping a few inches in water. The second part of the invention consists in employing similar condensers for collecting the fumes in the manufacture of sulphuric acid; in this case, water is not allowed to descend through the coke, but a jet of steam is admitted into the first condenser, as also into the sulphur chamber. The patentee states, that he obtains a much greater produce of acid from the condensers than from the sulphuric acid chamber in the same time, and can thus add more burners to the chamber, and he has obtained acid by using the condensers only.

Ibid.

Safety Letter-Box.

A new safety letter-box, which seems to combine the two essentials, simplicity and security, has been invented by Mr. Pearce, of St. Pancras-lane, city. Letters when deposited in it fall first on one inclined plane and thence on to another slanting in an opposite direction before they reach the bottom, a contrivance which effectually prevents the abstraction of letters from without. The plan has, it appears, been successfully adopted at the Gloucester post-office.

Lon. Mech. Mag.

Cooking by Gas.

At the Reform Club, in Pall Mall, a great number of operations in cookery are performed by gas, instead of charcoal; it is found to be more economical, as it can be turned nearly off when not in use, and is far more cleanly, and free from smell. The gas ascends from perforated pipes, in the form of a gridiron, through a bed of pumice-stone, which, being porous and fire-proof, soon becomes of a glowing red heat, and every operation of cooking, frying, broiling, stewing, roasting, boiling, &c., may be performed in the most easy and perfect manner.

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CIVIL ENGINEERING.

The Gauge Commission.

Analysis of Evidence given before the Royal Commissioners appointed to investigate the subject of the diversity of Railway Gauges.

(Continued from page 305.)

Mr. James Edward M'Connell:—Is, and has been for upwards of four years, superintendent of the locomotive department on the Birmingham and Gloucester railway, now part of the Bristol and Birmingham. If as large an amount can be got of evaporating space, compared with the weight of the engine, on the narrow as on the broad, they would be equal in that respect.

Dimensions of Mr. M'Connell's Locomotive Engine at Bromsgrove.

The dimensions of the Great Britain locomotive engine, constructed at Bromsgrove station, and now employed to work the heavy goods trains upon the Lickey Incline on the Bristol and Birmingham railway, are as follow, viz:—

	Ft.	In.		Ft.	In.
Diameter of cylinders,	0	18	Diameter of pump rams,	0	$2\frac{1}{8}$
Length of stroke,	0	26	Breadth of shell of fire-box,	4	$4\frac{1}{4}$
Diameter of each of the six wheels	0	45	Length of ditto, outside,	3	11
Distance from centre to centre of front wheels,	6	$9\frac{3}{4}$	Height from bottom to top,	6	3
			Height of lower edge of cylinder,	2	0

Distance from centre to centre of hind wheels,	6	11
Length of boiler,	12	0
Length of tank over boiler,	11	9
Breadth of ditto.	3	7
Depth of ditto.	2	7
Distance from centre to centre of cylinders,	6	2
Length of tubes, No. 134.	12	6
Diameter of ditto.	0	2
Diameter of piston rods,	0	3

Length of chimney,		6	9
Circumference of ditto,		5	6
Total weight of engine,	30 tons		
Weight on front wheels,	9 tons		
Weight on centre wheels,	12 tons		
Weight on hind wheels,	9 tons		
Height of smoke-box,		6	1½
Width of ditto,		4	10
Diameter of boiler cylinder vertically,		3	10
Ditto ditto horizontally,		3	9

The Lickey incline is one in thirty-seven, which is a very steep gradient, and has always been worked by a locomotive engine. For the last four years, engines were of so light a construction that they had not sufficient adhesion on the driving wheels; in order to test the relative economy of a heavy and light engine in working this steep gradient, witness made an engine which has been at work now the last two months, with a cylinder 18 inches diameter, stroke 26 inches, and the driving wheels 46 inches diameter, six wheels, all coupled. The engine carries its water in a tank on the top of a boiler, so as to give it the advantage of all the weight possible to increase the adhesion of the wheels, and it weighs, in working order, somewhere about 30 tons. There is a great variety in the weight of the engines on the two lines, from 10½ up to 30 tons; the average weight of the 30-inch cylinder passenger-engines is about 12½ tons, with 5 feet driving wheels. Four have 5ft. 6in. wheels, for mail and express trains, and weigh about 13 tons. The average speed of express trains about 30 miles an hour, with 15 tons load. The luggage van is about half a ton lighter than the passenger carriages, and is placed next the engine. For the last three years, the van has been placed there, on the recommendation of the Board of Trade, for public safety, and if they had two, or any empty carriages, they would be placed there to prevent risk to passengers. Is aware that the lighter the carriage with high velocity, the greater is the tendency to run off the rails, but thinks when the luggage-van is loaded, the weight is sufficient; and the empty carriage is about as heavy as the loaded van; should not place an empty van there; would place two loaded vans if he had them. The relative speed of heavy goods trains on the two lines averages on the broad 8¾ miles and 13 on the narrow. The broad gauge wagons do not load more heavily than the narrow; that is the result of the regular working of the traffic. 135 wagons upon the narrow gauge carried 138 tons net; and that on the broad gauge, 135 wagons carried 134 tons net. On one occasion, the gross load upon the broad gauge conveyed by Mr. Slaughter's engine was 235 tons 2 cwt.; the tare was 137 tons 12 cwt.; the net was 97 tons 10 cwt. On the narrow gauge the gross load was 254 tons 9 cwt., the tare 101 tons 17 cwt., and the net 152 tons 12 cwt. The wagons were taken and loaded expressly, that there should be as little dead weight as there possibly could; and this is a further proof of the comparative net and tare upon the two gauges. There were 36 wagons upon the narrow gauge, and 25 wagons upon the broad gauge. On the latter the gross load was 235; on the former 254. With 35 tons 15 cwt. less tare,

there was on the narrow gauge 55 tons 2 cwt. more net. Went up two inclines of 1 in 100 at a speed of 8 miles an hour. On other portions of the line, that is, on level portions of the line, and slight inclinations, our maximum speed was 25 miles an hour. Size of the engine on the broad gauge: cylinder 16 inches diameter, stroke 21 inches, wheel 54 inches, gross weight of engine and tender 23 tons. Size of engine on the narrow gauge: cylinder 15 inches diameter, stroke 24 inches, wheel 54 inches, weight of engine and tender 27 tons. All six wheels were coupled in both cases, so as to get the utmost adhesion to the engine. The Birmingham and Gloucester is laid in longitudinal bearings, thinks the Bristol and Gloucester is also laid with them. An increase of the boilers would increase the weight of the machine, and thinks that, at a high velocity, a very heavy engine would act very injuriously on the rails; so far as it is safe for the rails, the increase of the weight and power of the engines to produce speed, can be got on the narrow as well as on the broad gauge. The consumption of coke, consequent upon the generation of more steam, would be greater, but thinks it is cheaper to work with one large powerful engine than with two small ones: has an engine on the narrow gauge capable of taking 600 to 700 tons, and his engine will take 1000 tons on lines of easy gradients, at 10 or 12 miles an hour. Thinks the injury to the rails and permanent way would be very much increased by increased weight and speed. Believes the injury to the permanent way on both gauges is more caused by high velocity than increase of weight. Has observed that the shocks received from the fast trains appear to affect the rails more than the slow, and the contractors for the repairs do not like fast trains so well as heavy ones at slow speed.

Has not seen the fractures of axles on the broad gauge; has seen them on the narrow. A very extraordinary change takes place in axles from the constant blows the wheels receive; it amounts to what is called cold swedging on the anvil, and renders them more brittle, which must exist to the same extent on the broad gauge; on the narrow, axles have broken that had worked three or four years, and though at first they might be fibrous in their texture, yet on fracture they appeared as if broken up into small crystals; considers the breakage of axles must arise generally from this, and the greatest care is required to get them of the best manufacture, and of the toughest and strongest iron. Prefers those of the patent axle company, near Wednesbury, with radial bars all welded together, and finds them, from experience, superior to the Low Moor. The elasticity of the long bearing of the axle would affect the wheel, throw it out of the perpendicular, tend to injure the railway, and force it out of gauge; on curves, an objection arises again to the broad gauge, as one wheel has to travel over greater surface than the other, there is either a straining of the wheel, or a twisting of the axle; the axle will be strained and deteriorated in this manner more on the broad gauge than on the narrow.

100 miles is a fair day's work for an engine, but he sees no objection to doing more; thinks that by seeing that the engines are in good

order, and changing them once a fortnight, there is economy in working as much as 150 miles; the steam being raised in fewer engines would save fuel. Is aware that the London and Birmingham Company change their engines at Wolverton; they make a trip each way, being 120 miles a-day, without putting out the fire. If the gauge were uniform at Gloucester, one-third of the present staff of porters could do the goods trade; at present they are kept for lifting goods from one wagon, and repacking them in another, which requires five to six hours from their arrival. The guards' returns show, during the month of August, an average detention of 16 minutes for passenger trains. The detention to goods trains by transhipment from one gauge to another, cannot be estimated at less than from 4½ to 5 hours. Thinks the alteration of gauge matter of necessity, and that the cost would form a very small practical part of the ultimate profit. Supposing the cost to be £5,000 a mile, has no doubt the increased profit would more than cover the interest of the outlay, but thinks £5000 is very much too high a sum for the alteration, for this reason—with respect to the wagon-stock, it would take for instance for 50 miles of railway a certain number of wagons, but for 100 miles of railway it does not take a double number of wagons, because if the wagons work through, a small addition, comparatively speaking, would work the 100 miles beyond what is required for the 50. And so with respect to all the carrying stock. Having the carrying stock for the Birmingham and Gloucester portion, it would require a very small addition for working the other portion of the line, comparatively speaking. To lay down the broad gauge to Birmingham would amount to a complete demolition of the present works; the bridges and tunnels are too narrow, and the stations must be removed. Imagines the expense would be very great, almost a re-making of the line. The largest goods train he ever knew to arrive from the north at Gloucester was 320 or 330 tons gross weight, but thinks only a small quantity was transhipped to the broad gauge, as it consisted chiefly of salt shipped at Gloucester. In many cases, a day is occupied in transhipping. Recollects 40 or 50 loaded goods wagons waiting at Gloucester a fortnight for broad gauge wagons to come up, and that may occur either way. No mechanical arrangement at Gloucester for transferring goods, but manual labor and cranes. At first, shifting on low trucks was proposed, but on inquiry, they did not go to this expense. Goods wagons placed on additional trucks would not pass under the narrow gauge bridges, but they could on the broad. The weight of the additional trucks on the broad gauge would be about 3 tons 5 cwt. Although mechanical arrangements may work well experimentally, believes they will be found in practice totally unfit for every day traffic. The strength of the railway carriage and body is increased by their being united, and being exposed to rough usage, a separation would be a constant cause of damage to the carriage and the goods in it. Thinks that detaching the bodies of passenger carriages from the wheels and frames would be highly objectionable. High velocities would not increase the expense on the narrow as much as on the broad, the lighter machine on the narrow

having less tendency to damage the rails. The permanent way on both lines is kept up by contract, and the expense on the Birmingham and Gloucester is about £100 per mile. The rails on the latter were originally too light, and the timbers and cross sleepers of the embankments not sufficiently seasoned, nor put into the Kyanizing process, so that the expense of repair has thus been increased. A line well made would be kept up at a very low expense. Believes that 75 lb. rails are now adopted on all lines, and they are to be substituted for those on the Birmingham and Gloucester.

Description of the improvements on the narrow gauge engines with six wheels.—The general features of both are as follows: Mr. Robert Stephenson has always advocated the six-wheel engine, and has made it; he has improved it very much; he has simplified the arrangement and construction of the engine; he has adapted the outside cylinder to his passenger engines, with a framing riveted to the boiler plates; and he works his slide valves in a vertical direction. He has very much increased the length of the boiler. The average length, before it was varied by Mr. Stephenson, was from 8 to 10 feet, and now Mr Stephenson has adopted the 12 feet tube and upwards, thereby safely calculating that a very great economy is effected in the consumption of fuel, that is, that a less proportion of heat is allowed to escape unprofitably up the chimney. This engine is found to answer in practice exceedingly well, inasmuch as it gives a greater length of engine on the rails, and increases very much its steadiness at a high speed. He has also a patent for placing the whole six wheels between the fire-box and the smoke-box, whereby he is enabled to distribute the weight more equally on the wheels. In working the engine he also uses what is termed the expansive motion, the link motion. It enables the driver of the engine to regulate the supply of steam to the cylinder in proportion to the load. There are various plans of doing so. There is a plan proposed and patented by a Mr. Bodmer of Manchester and Mr. Myers of Malhausen on the Continent for doing the same thing, all tending to the saving of steam, and providing the quantity of steam requisite to overcome the load. The size of the engine is increased. At one time it was considered that from 12 to 13 inch cylinders was a good average size for working railways. Now we find from experience that economy of working is very much assisted by taking the train by one heavy engine instead of two light ones: that is to say, you save the wages of two men; and the expense of repairs is very much reduced, and materials, for instance, oil and tallow, &c., and the consumption of coke in the one engine is not at all equal to the consumption of the two, which would only do the same amount of work. The practice has become general on narrow gauge railways to adopt 15 inch cylinders instead of 12 inch, and even higher than that. There are at present engines being made at Messrs. Sharp's manufactory at Manchester with 18 inch cylinders of nearly the same size as the one at work at Bromsgrove, but with 24 inch stroke, 4 feet 6 inches driving wheels. They are intended for the Sheffield and Manchester Railway and the Manchester and Birmingham, and

it is calculated they will be of very great service with heavy goods trains, and enable them to carry at a very low cost indeed. Those engines will be equal to take 800 tons, and travel with ease when they are at work; providing that, so far as the power of an engine is concerned, the power of getting machinery on the narrow gauge is sufficient to take any load; it will be quite equal to produce it, at least as far as it can properly be adopted without increasing the weight of the machine to the injury of the permanent way. Our power is increased more than it would be warrantable to increase the weight of the machine, of which the engine at work at Bromsgrove is an instance; for although it is 30 tons in weight, the whole six wheels can be made to spin round and slip with the six wheels coupled. That settles the point completely that we can get sufficient power on the narrow gauge, without at all injuring the construction of the engine, or rendering it objectionable. With respect to those engines that are in construction by Messrs. Sharp at present with the 18 inch cylinder, it is a most remarkable thing that the cylinders are not placed outside the wheels, but inside, so that there is room for two 18 inch cylinders in the narrow gauge to be constructed inside the wheels, working with the crank shaft. That does not much affect the centre of gravity; the cylinder is kept low; the valves are underneath in this case. The principal objection is the crank shaft, to get room for the boiler; but on the drawings and on the elevation of the engine, the centre of gravity does not seem at all to be too high. Those engines have four eccentrics, and are to be worked with the link motion. Thinks a speed of from 12 to 20 miles an hour with a goods train, as great as would be safe with this weight of engine on either gauge. These engines not used for passenger trains, the wheels being only 4 feet 6 inches in diameter, and wanting adhesion as well as power.

Description of the improvements on narrow gauge engines of the second kind, namely, those with four wheels.—Mr. Bury has always been a maker and supporter of the four-wheel locomotive engine. They are in use on the London and Birmingham Railway and several other railways. They also have been much improved; the boilers have been lengthened to about 11 feet; they have been increased in size with 15 inch cylinders and 2 feet stroke. The interval between the fore and hind axle is somewhere about 6 to 7 feet; in those of Mr. Stephenson's the distance is rather less than 12 feet; they are all in the space between the fire-box and the smoke-box. A plan is adopted on the London and Birmingham, of attaching the engine to the tender by a draw spring, rendering it an 8-wheeled machine. Believes, with the inside bearings adopted by Mr. Bury, that the engine would go on with the axle broken. Has seen them going 12 to 14 miles an hour with the axle cut through. Has known the axle broken, and not discovered till the train was at the station. The breaking of the axle takes place close to the journal, and sometimes at the corner of the crank, the iron being cross there, and not so strong. Prefers the strait axle with outside cylinders for safety. The chief objection to the crank axle is liability to give way.

(To be continued.)

Remarks on Iron Rails, for Railways. By R. RITCHIE, C. E.

Mr. Barlow came to the conclusion, that the strength of a bar should be double that of the mean strain or load. In his first report, he thought from 10 to 20 per cent. would be sufficient; that is, for a 12-ton engine, as the weight is at present distributed, a strength of 7 tons would be ample provision; and with greater accuracy of construction, a less strength would suffice; or rather, allowing the same strength, an engine of 14 or 16 tons might be passed over with greater confidence. Thus, for 12 tons' weight, with a velocity of about 35 miles per hour, 7 tons would allow a surplus strength of 16 per cent. beyond double the mean strain. The deductions from his experiments led him to recommend that the section of an iron rail for a 5-feet bearing, with strength 7 tons, should not exceed 5 inches in depth; that the head ought not to be less than 2·25 lb. per yard, and be 1 inch in depth; that the whole weight at the sections should be 67·4 lb. per yard; the thickness of the middle rib, ·85 inch; depth of bottom web, 1·66 inch; and breadth of ditto, 1⅛ inch; that the deflection of such a rail, with 3 tons, would be ·064 inch.

For bearings of less width, he did not reduce the weight or size of the head, but kept it at the same section, decreasing the whole weight and depth of the rail: thus for a strength 7 tons, with a 3-feet bearing, the whole weight was 51·4 lb., whole depth 4½ inches, depth of bottom web 1 inch, breadth 1·25 inch, thickness of middle rib ·6 inch, deflection with 3 tons was ·024 inch.

Notwithstanding that Professor Barlow expressed a strong opinion in favor of the single-flanched rail over the double,—that he could see no advantage the latter possessed to compensate for its actual and obvious defects, that he considered it inferior in strength and convenience in fixing, and that the advantage it was supposed to possess, namely, that it might be turned when the upper table was worn down, was impracticable, and that he saw no advantage in the broad bearing,—still the double-headed rail, in practice, has almost entirely superseded the single one: whether the adoption of the double one arises from affording greater convenience to the rail layer, and facilities for keying it, and the advantage of having the power of reversing it, and selecting the best side, or from the manifest advantage of a broad bearing to the rail,—this form is now generally preferred.

The Liverpool and Manchester Railway Company has of recent years adopted a double parallel rail of a peculiar section; not admitting, however, of the power of turning it. The object to be attained in adopting this shape, is stated to be, that by having the part of the rail upon which the flanch of the wheel acts, of the same outline as the flanch itself, greater strength is given to the rail, while the other edge of the rail is lightened. These rails have been laid down at 60 and 75 lb. per yard.

The more common and useful form of a double parallel rail, is when the segmental outline is the same at top and bottom; for although it cannot be denied that the weight of the bottom flanch does not add

proportionably to the strength of the rail, nor even that the power of turning it is at all times practicable,—yet there cannot be any doubt that this form, for railways constructed on separate blocks and sleepers, presents many advantages; and besides, as the cost is nearly the same for a rail with the top and bottom flanches alike, with that where the bottom web is somewhat lighter, no hesitation can exist in preferring the former, however much theoretical deductions may mystify the subject.

A double parallel rail, weighing 75 lb. per yard, has been laid down on the London and Birmingham, Eastern Counties, South Eastern, Edinburgh and Glasgow, and many other railways. The whole depth is 5 inches, the top and base are the same sections, 2·5 inches, the thickness of middle rib is about $\frac{3}{4}$ of an inch or less.

A double parallel rail has been used upon the Grand Junction and other railways, weighing 62 lb. per yard; whole depth, 4·5 inches.

A double parallel rail, about 65 lb. per yard, of which the whole depth is about $4\frac{1}{2}$ inches, has been laid down on some parts of the London and Birmingham railway.

A 75 lb. rail was laid down on the Edinburgh and Glasgow railway. The inner side of the chair being curved, admits of ample space for the key to wedge the rail firmly.

The rail and chair which are now laying down on the North British railway are about 70 lb. per yard, in 12 and 16 feet lengths. The top and base are different sections, probably adopted with a view of saving in the weight, but presenting no corresponding advantages. The keys or wedges are made of oak, and are small in size.

It seems generally agreed, that the bearing surface for the wheels to run upon, without being too heavy, or so narrow as in an additional degree to wear the wheels, should be about $2\frac{1}{2}$ inches; and hence this size of a head is generally adopted for public railways. Although, both theoretically and practically, it has been assumed, by Messrs. N. Wood, Barlow, and E. Wood, that the strongest form of rail is that of which, with sufficient depth for rigidity, the base does not contain too great a quantity of material,—and though Mr. Barlow has given a formula for calculating the section of greatest strength—still the great object that the public are interested in, is the best form of rail for safety; and of which, while it has sufficient strength to bear upon it heavy loads in motion, the bearers should not be too far apart, to increase in the least degree the amount of either vertical or lateral deflection. When a rail possesses these advantages, its exact shape on mathematical principles is of less importance than its convenience of being easily fixed, and quickly shifted. Hence, while the single parallel rail is decreasing in practical application, the double one, from its convenience, is progressively extending. A knowledge of these facts is essentially necessary for every one engaged or connected with railways, whether he be a director or shareholder, whether an engineer or manager. With all the knowledge yet acquired, there is ample evidence of the uncertainty which still hangs around the subject; and the great expense it has already cost some of the older companies in making alterations, shows that experience to them has been

dearly bought. For example, it has been shown that the Liverpool and Manchester Railway Company has had several times to alter the rails on that line; to increase the weight from 35 lb., the weight of the original rail, to 50 lb., 65 lb., and 75 lb. per yard, successively; while the London and Birmingham Railway Company, notwithstanding the advantages derived from Mr. Barlow's able report, was obliged to reduce the width of the bearings or supports from 5 feet to 3 feet 9 inches, and to increase the weight of the rails from 64 lb. to 75 lb. On other railways equally expensive alterations have been made. There is every probability, therefore, that, so long as that plan of railway construction continues, whatever may be the first cost to railway companies, a still greater weight must be given to the rails, and a still farther reduction of the width of the bearers must take place, in order to adapt the stability to increased rapidity of traction.

It may be observed that the rails have gradually been increased in strength since steam power was introduced; the bars are usually made in 12, 15, and 16 feet lengths, with square or butt ends, and are laid end to end, the earlier complex contrivances to secure the joints being all dispensed with, and the half-lap joints now rarely used. About $\frac{1}{16}$ of an inch, at least, should be left between the ends for expansion; for it has been ascertained that a bar of 15 feet in length will expand about $\frac{1}{11}$ of an inch at 75° F. Some have, indeed, proposed to place a small piece of wood between the ends of rails, as the different expanding properties of wood and iron would fill the space, the wood expanding as the iron contracts: but such a plan is liable to objection from the wood being likely to be shaken out, and the space being left vacant. There is no part of railway construction that requires more accuracy of fitting than the joints: the squareness of the ends, and the space allowed for expansion, cannot be too carefully regulated. Instead of that, how often are seen spaces at the joints of different widths, and the ends of the bars in juxtaposition, without parallelism and uniformity of level; thus increasing the amount of friction, adding to the jolting and rocking motion, and to the risk of the wheels of carriages being thrown off the rails."

Civ. Eng. & Arc. Jour.

On a new method of Boring for Artesian Springs, by M. Fauvelle, *of Perpignan, in France. Read by* Mr. Vignolles, *being furnished by* M. Arago, *for the purpose of being communicated to the Association, M. Arago himself being prevented by illness from attending.*

The paper was an abridged translation of M. Fauvelle's own account, in which he says:—" In 1833, I was present at the boring of an artesian well at Rivesaltes; the water was found, and spouted up abundantly. They proceeded to the tubing, and for that purpose enlarged the bore-hole from the top downwards. I was struck by observing that it was no longer necessary to draw the boring tools to get

rid of the material, and that the water, rising from the bottom brought up with it, in a state of solution, all the soil which the enlarging tools detached from the sides. I immediately observed to my friend, M. Bassal, who was with me—This is a remarkable fact and one very easy to imitate; if, through a hollow boring rod, water be sent down into the bore-hole as it is sunk, the water, in coming up again, must bring with it all the drilled particles. On this principle I started to establish a new method of boring. The apparatus is composed of a hollow boring rod, formed of wrought iron tubes screwed end to end: the lower end of the hollow rod is armed with a perforating tool, suited to the character of the strata which have to be encountered. The diameter of the tool is larger than the diameter of the tubular rod, in order to form around it an annular space through which the water and the excavated material may rise up. The upper end of the hollow rod is connected with a force-pump by jointed or flexible tubes, which will follow the descending movement of the boring tube for an extent of some yards. This boring tube may be either worked by a rotary movement with a turning handle or by percussion with a jumper. The frame and tackle for lifting, lowering, and sustaining the boring tube, offer nothing particular. When the boring tube is to be worked the pump must be first put in motion. Through the interior of the tube a column of water is sent down to the bottom of the bore-holes, which water, rising in the annular space between the exterior of the hollow boring rod and the sides of the bore-hole, creates an ascending current which carries up the triturated soil: the boring tube is then worked like an ordinary boring rod; and as the material is acted upon by the tool at the lower end, it is immediately carried up to the top of the bore-hole by the ascending current of water. It is a consequence of this operation that the cuttings being constantly carried up by the water, there is no longer any occasion to draw up the boring tube to clear them away, making a very great saving of time. Another important and certainly no less advantage, is, that the boring tools never get clogged by the soil; they work constantly (without meeting obstructions) through the strata to be penetrated, thus getting rid at once of nine-tenths of the difficulties of boring. In addition, it should be mentioned, that experience has shown there are no slips in any ground which ordinary boring rods can penetrate; that the boring tube works at 100 yards in depth with as much facility as when only ten yards down, and that from the very circumstance of its being a hollow rod, it presents more resistance to torsion than a solid rod of equal thickness and quite as much resistance to traction: these are the principal advantages of the new system of boring. Indeed these advantages have been fully confirmed by the borings which I have just completed at Perpignan. This boring was commenced on the 1st July and was completed on the 23rd, by finding the artesian water at a depth of 170 métres (560 English feet.) If from these twenty-three days, each of ten hours' work, are deducted three Sundays and six lost days, there remain fourteen days or one hundred and forty hours of actual work; which is upwards of 1 métre per hour, that is, ten times the work of an ordinary boring rod. In the method I have de-

scribed, it will be perceived that the water is injected through the interior of the boring rod. Experience has taught me that when gravel, or stones of some size are likely to be met with, it is better to inject the water by the bore-hole, and let it rise through the boring tube. The additional velocity which may be thereby given to the water, and the greater accuracy of calibre of the tube, allow the free ascent of all substances which may be found at the bottom of the bore-hole, and which the former mode of working may not so readily accomplish. I have brought up by this latter way stones of 6 centimétres long and 3 thick ($2\frac{1}{2}$ by $1\frac{1}{4}$ English inches.) The idea of making the water remount through the interior of the boring tube suggests an easy mode of boring below a film (sheet) of flowing water: it would be sufficient to close the orifice of the bore-hole hermetically, still, however, so as to allow the boring tube to work, but yet so that the flowing water should be always forced down to the bottom of the bore-hole to find its way to a vent: it would thus draw up and carry away all the detritus. If, in addition to the above, we consider the possibility of making the hollow stem of the boring rod of wood, and of balancing it so that it would weigh no more than the water in which it has to move, the problem of boring to depths of 1000 mètres (1100 yards) and upwards would appear to be solved. In the square of St. Dominique, at Perpignan, a boring had been carried on upon the old method for upwards of eleven months for the purpose of forming an artesian well, and the water had not been found." Fauvelle placed his new tube alongside the old boring tackle, and soon got down to a depth of nearly 100 yards when an accident occured which would have required some days to remedy. Fauvelle decided upon abandoning the bore hole already sunk so deep, and commencing a new one, satisfied that there would thereby be a saving in time. The rate of sinking was equal to four English feet per hour of the time the hollow boring rod was actually at work, the depth of 560 English feet having been obtained in 140 working hours, for a bore-hole of about six English inches in diameter. M. Arago, who had seen the rods of Fauvelle at work, mentions how fully they answered, and that the large powerful tools at the bottom of the hollow boring rod cut easily through the hardest strata; he confirmed the fact of the large sized stones and gravel coming up with the ascending current, having himself watched them. He also mentioned, that such was the opinion of the people in the vicinity of Perpignan, and so much was water wanted, that orders for the sinking upwards of 200 artesian wells had been given to Fauvelle. The introduction of this system into this country, especially if combined with the Chinese or percussive system of boring, as practised with bore-holes of very large diameter, at the Saarbruck mines, and at many other places on the Continent, must be productive of great benefit, and would not merely effect a saving of money and labor, but the paramount advantage of immediately solving the question of the existence of coal, minerals, water, &c.

Sir John Guest asked Mr. Vignolles to explain the system of percussion boring, for the information of those gentlemen present who might not be acquainted with it.—Mr. Vignolles said, instead of

boring with augers or rods, there was a heavy weight suspended by a rope and pulley; and fixed to the bottom of the weight was a tool of the crown form, viz., a circular tool of iron indented at the bottom. There was no description of rock on which he had tried it that this tool did not penetrate with facility. The prejudice of English workmen, however, had hitherto prevented its introduction in this country, but he had no doubt it would make its way, particularly if it could be combined with Fauvelle's system.—J. Lobb, Esq., Mayor of Southampton, wished to ask a question relative to the applicability of Fauvelle's plan to the boring of the Southampton artesian well. They had got to the depth of 1200 feet with a bore 6 inches in diameter, and the expenses had been nearly 20,000*l.*; this system, however, seemed to diminish the expense of boring in an extraordinary manner; and he wished to ask if it could be applied to the present boring at the Southamptom Common?—Mr. Vignolles, as an engineer, had no hesitation whatever in saying that it could be applied without difficulty. If they wanted force to send the water down the tube, they might use a steam-engine.—Dr. Robison suggested that a deputation from the Section should go to the works of the Southampton well, and inspect them.—Mr. J. Hill said that percussion had long been used in this country. They had used that plan whenever they came to hard substances in the Southampton boring. The rods were drawn up by a windlass, and dropped down a foot or six inches; and after the material was loosened the rods were drawn, and the pulverized material raised up by a cylinder.—Mr. Vignolles said this was different from the Chinese system of percussion, where a rope was used, which saved the trouble and loss of time in drawing the rods. The power required for sending down the water on Fauvelle's plan was much less than might be supposed.—The Marquis of Northampton suggested that a committee of the Geological Section should be invited to accompany the committee from this Section.—Dr. Lankester expressed his warm approval of M. Fauvelle's plan, and his opinion of its applicability. A conversation followed, in the course of which Sir John Guest said the weight of a hollow rod, three inches in diameter, and the iron a quarter of an inch thick, would be less than that of a solid rod of an inch diameter: the weight would be further lessened by the rod floating in water.—*Trans. Brit. Assoc.* Athenæum.

AMERICAN PATENTS.

List of American Patents which issued in the month of November, 1845,—with Exemplifications, by Charles M. Keller, *late Chief Examiner in the United States Patent Office.*

1. For an *Improvement in the Cultivator Tooth;* David B Rogers Stafford, New York, November 1.

The body and shank of the tooth is made of sheet metal swaged into the required form, the shank being so formed, that a horizontal section passing through that part of it which is inserted in the frame,

would represent a letter ᴜ, so that by driving into it, from the top, a properly formed wedge will secure it to the beam in all directions.

Claim.—"Having thus fully described my improvements, what I claim as my invention, and desire to secure by letters patent, is the shank of the tooth, so formed of thin metal as to receive a wedge in its recess, in the manner described, for the purpose of firmly connecting it with the beam in all directions, as set forth."

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2. For an *Improvement in Hats, such as are used by Firemen and Watchmen;* James Brown, Newark, New Jersey, November 1.

The patentee says:—"I make the body of my improved hats of wool, and by means of proper moulds, or blocks, I form upon their crowns any desired number of welts or ribs; these welts or ribs I fill on the inside with some hard substance which will cause them to preserve their form, and to resist the effects of a blow upon them."

This is claimed as an improvement on the well known method of making such hats of leather with welts or ribs.

Claim.—"Having thus fully described the nature of my improved hat, which is principally intended for the use of watchmen and firemen, I do hereby declare that I do not claim to have invented anything new in the manner of forming such hats, but what I do claim as new, and desire to secure by letters patent, is the manner herein described of forming or combining of welts or ribs with hats having bodies of wool; such ribs being strengthened by filling the inside of the same with any suitable material, in the manner set forth, by which combination I form a hat, as hereinbefore stated, of a material not hitherto considered as applicable thereto, and possessing the desirable properties of lightness, and of being brought into market at a cost far below those that have been heretofore made."

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3. For an *Improvement in Stoves, for Heating Apartments;* Jordan L. Mott, New York, November 1.

This is for improvements applied to a stove having Mott's feeder, for preparing and supplying the coal to the grate, placed below and back of the shelf on which the coal rests; and these consist in bulging out the back of the stove, so as to give it an inclination backwards from the bottom to the upper line of the grate, and thence from that line upwards, giving it an inclination forward.

Claim.—"What I claim is the combination of the feeder, as described, with the bulged form of the back. I further claim the drawing in the upper segment of the back, over the coal, in combination with the shelf above the grate, and this I do claim without reference to the bulging of the lower segment."

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4. For an *Improvement in the Kitchen Range;* Jordan L. Mott, New York, November 1.

This range has two ovens with the fire chamber between them, the draught from the firechamber being first over the top of the ovens, down

the side near the front, then under the bottom to the rear, then up the back to the connexion with the flue leading to the chimney. In this way the draught, by means of dampers, can pass around both, or either of the ovens. To facilitate the operation of cooking, stationary boiler holes are placed over one oven, and a rotary top over the other, and extending partly over the fire place.

Claim.—"What I claim is the *combination*, as follows: The top range or stove, furnished with both *rotary boiler plates and stationary boiler openings* in combination with the *divided draught*, by which the *heat* can be made to act either on the rotary plate or the stationary boilers, or both, at pleasure, by merely changing the dampers."

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5. For an *Improvement in the Corn Cutter and Grinder;* James P. Ross, Lewisburg, Pennsylvania, November 1.

The corn and the cob are cut by a series of eccentric or circular saw plates on a shaft, the teeth of which pass between permanent bars forming a comb, and when thus cut the pieces are delivered to a conical mill, where the whole is properly ground.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the series of eccentric or regular saw plates on the cylinder, in combination with the comb, for the purpose of cutting corn in the ear, or other substance, substantially as herein described, and in combination therewith. I also claim the conical mill for grinding the grain, &c., after being cut, substantially as herein described."

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6. For *Improvements in the Cart;* Thomas Mussey, New London, Connecticut, November 1.

We are under the necessity of omitting the claims in this case, as they are wholly dependent on the drawings; they are however limited, the first, to an arrangement of a windlass, cog wheels, straps, &c., by which the forward part of the cart can be lifted to tilt out the load, the cart being made so as to place the greater part of the load forward of the wheels—and the second to an arrangement of the tail board with levers and connecting straps by which the tail board is held up, as the body of the cart is tilted.

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7. For *Improvements in the Machine for Boring Timber;* Andrew Weikart, Green Village, Ohio, November 1.

This improvement is for an arrangement of parts for securing the frame of the boring machine to the timber to be bored, and the general nature of the mechanical arrangement for this purpose can be clearly gathered from the following;

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the combination of the strap, metallic plates, or bars, connected by a cross bar, and suspended on pivots, levers, and nicked plate, as set forth, for securing the machine to the timber to be bored, said strap being hooked to the lever and passed under

the timber, around the rollers, and between the bar and the side of the box, as described."

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8. For an *Improvement in the Manifold Writing Desk;* John White, Marshall, Michigan, November 1.

Claim.—" What I claim as my invention, and which I desire to secure by letters patent, is combining the internal escritoir with the external folding desk, in the manner and for the purpose set forth."

The escritoir is a case for containing papers, books, &c., which slides up and down in the main frame, and this is surrounded with folding desks for writing.

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9. For an *Improvement in the Apparatus for Tanning Leather;* Francis D. Parmelee, Akron, Ohio, November 1.

The vats in which the hides are suspended are so constructed and arranged as to permit the liquor, which has acted on the hides, to run off, and above these vats there is a traversing carriage which delivers the ooze on to the hides.

Claim.—" Having thus fully described my apparatus for tanning hides, what I claim as my invention, and desire to secure by letters patent, is the combination of a traversing carriage for distributing the ooze on the hides, substantially as above described, with a vat or vats, in which said hides are suspended, and from which the spent liquor can drain."

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10. For an *Improvement in the Brake for Arresting Carriages;* William Dunning, Dunningsville, Pennsylvania, November 1.

Claim.—" Having thus fully described the construction and operation of my improvement, what I claim as new therein, and desire to secure by letters patent, is the useful combination of the brake or rubber with a shaft or shafts, joined to the goosenecks by a rule joint, in the manner and for the purpose herein set forth and fully made known."

The shaft (or shafts) is jointed to the goosenecks by rule joints, so that it can bend up and back, but not down, and the sliding brake is jointed to the shaft by a connecting rod, so that in going down hill the weight of the carriage shall force the brake against the wheels, and thus arrest the downward motion of the carriage.

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11. For an *Improvement in the Splints for Setting Fractured Limbs;* William Mills and Mahlon Hoar, New Athens, Ohio, November 8.

Claim.—" What we claim as our invention, and desire to secure by letters patent, is the construction of a fracture apparatus with four adjustable slide-splints, connected with each other by means of circular metallic hoops or bands, the upper and lower sets of splints being connected by means of the quadrant hinge joint and the ankle joint, similarly constructed. We do not claim these parts separately, but in combination, as above described."

12. For an *Improvement in the Method of Mounting Hatters' Kettles;* Russel Wildman, Hartford, Connecticut, November 8.

Claim.—"What I claim as new, and desire to secure by letters patent, is the arrangement of the draught in combination with the stoke flue, by which the smoke flue becomes the stoke flue, in the manner described."

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13. For an *Improved Arrangement of the Apparatus for Bleaching Cotton, &c.;* Moses Pierce, Norwich, Connecticut, November 8.

Claim.—"I am aware that the washing machine, the keir for boiling, first in lime and then in an alkali, the "chemics" or vats for containing the chlorine, and the "sours" or vats for containing the acid solutions, have all heretofore been used separately, the pieces of fabric being attached together to introduce them to the washing machine, and then separated to transport them by hand to the keir, and then re-transported and re-attached, to rewash them, and the same with reference to the chemics, and sours, and the washer, the whole of these operations of attaching, detaching, conveying, and reconveying being done by hand; and therefore I wish it to be distinctly understood that I do not claim as my invention the using of these in succession in the process of bleaching, nor do I claim the passing of wet fabrics from a tub or vat, between rollers, to force out the liquid, as this combination has heretofore been known and used; but what I do claim as my invention, and desire to secure by letters patent, is combining the washing machine with the keir, by means of carrying rollers or belts, provided with a reversed motion, so that the fabrics can be conveyed from the washer to the keir, and back from the keir to the washer, as herein described.

"I also claim combining the washer severally with the chemics or vat for containing chlorine, &c., in the manner described, so that the fabric may be conveyed from the washer to the chemics and the squeezing rollers, as herein described, and, in combination with this last combination, the arrangement of the "sours" or vats for containing the acid solution, and the set of squeeze rollers which receive the fabrics from the sours after they have been conveyed therein from the first set of squeeze rollers, and reconveying them to the washer, as herein described.

"And, finally, I claim combining together the washing machine, the keir, and the chemics, the first set of squeeze rollers, the sours and the second set of squeeze rollers, in the manner described, by means of which the various operations in the process of bleaching are connected together, so as to convey and reconvey the fabrics from the one to the other in the order required, substantially as herein described."

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14. For an *Improvement in the Ink holder or Inkstand;* Daniel Harrington, Philadelphia, Pennsylvania, November 8.

Claim.—"Having thus fully described the nature of my improved ink holder, and shown the operation thereof, what I claim therein as

new, is making the rotary top of the ink holder, with pen holes, and a cup-formed recess in the middle, fitting in a large central opening in the permanent top, which is also provided with pen holes, in like manner, as the rotating top; when the two are combined by means of the spring handle, which secures the two together, and affords an easy and ready mode of removing the top to supply ink, whilst it answers the purpose of a ball handle, to carry the ink holder.

"And I do hereby declare that I do not intend to limit myself to the particular form of the respective parts, as herein set forth and represented, but to vary these as I may think proper, whilst the general form and combination are substantially the same with those herein fully made known."

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15. For *Improvements in Machinery for making Lead Pipes;* Nathan Butrick, Jr., Chelmsford, Massachusetts, November 8.

Claim.—"Having thus described my invention, I shall claim the above described peculiar manner in which I arrange the cylinder with respect to one or two melting cisterns, and the furnace whereby the said cylinder is heated wholly or partially by the fire of the furnace, and receives its supply of lead, as above specified.

"I also claim the combination of the air chamber with the forcing cylinder, and the pipe former, in the manner and for the purpose or objects as above specified.

"I also claim the arrangement of the air chamber, within, or partially within, the melting cistern or cisterns, for the purpose of melting any lead which at any time may congeal, or may have congealed, within the said air chamber, the said lead being rendered fluid by means of heat proceeding from the molten lead of the kettles, and passing through the sides (or a portion thereof) of the air chamber."

The cylinder from which the lead is to be forced, is surrounded by a furnace, and provided with a piston to make the force pump double acting, and on each side of the cylinder, and partly within the furnace is placed a melting kettle, the two communicating by apertures with the cylinder, which is also connected with an air vessel above, from which projects the tube or die with a core within for forming the pipe.

As the piston moves in one direction, the pipe leading from the cylinder to the air vessel is open, which permits the molten lead to pass into the air vessel, and by the elasticity of the air is forced through the die, the opposite end of the cylinder being in the mean time supplied with lead from the other kettle preparatory to its operation on the return of the piston.

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16. For an *Improvement in the Cooking Stove;* called the "Improved Empire"—John R. Chollar, Eber Jones and Peter Low; Troy, New York, November 8.

The patentees say,—" The nature of our invention consists, first, in the method of attaching the hearth of the fire chamber to the stove without casting any projections on the stove plate, by providing a

flanch to the bottom and sides of that part of the hearth which is towards the stove, and to bear against the stove plate, and with another flanch beyond the first sufficiently far to pass within the stove plate and hang on it; in this manner the hearth is sustained by having the edge of the stove plate embraced between the two flanches. And, secondly, in uniting the oven bottom with the stove bottom in such manner as to form the flues with cemented air-tight joints, the stove bottom being provided with two vertical plates which extend up to the oven bottom composed of three plates, with the edges bent down and resting against the sides of the vertical plates projecting from the stove bottom, the junction of the edges of the plates being such as to form channels for the reception of cement of any kind to render the joints air-tight.

"We claim the method, herein described, of forming the oven bottom, and uniting it with the flue division plates, by the bent or curved edges of the plates forming the oven bottom, and fitting against the division plates of the flues in such manner as to receive a cement to render the joints air-tight, substantially as herein described."

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17. For an *Improvement in the Instrument for Extracting Teeth;* John W. Baker & William W. Riley, Columbus, Ohio, November 8.

This is for combining the hook with the forceps handles, by having the hook turn on the end of one of the handles, whilst its upper end or projection is jointed to the end of the other handle, so that the working of the handles will open and close the hook.

Claim.—" What we claim as our invention, and desire to secure by letters patent, is the combination of the forceps handles, with the manner of controlling the hook, substantially in the manner and for the purpose described."

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18. For an *Improvement in the Machine for Mortising Sash Stuff;* Almon Doures, St. Clair, Michigan, November 8.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the combination of the mallets and spring-hooks with the treddles for operating the mortising tools; that is to say, I claim attaching spring-hooks, having their lower ends tapered, to the sides of the sliding mallets, which, on the descent of the said mallets, come in contact with stops or cans on the frame, by which the direction of the hooks is changed inward, causing the hook to pass under the head of the cutting tool simultaneously with the descent of the mallet, so that when the mallet is again raised with the hook, it draws up with it the cutting tool to the desired height, when the hook by its tapered form and effort to assume its original position, recedes from the cutting tool, until it is entirely liberated from it."

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19. For an *Improvement in the Plough;* John Ball, Greentown, Ohio, November 8.

Claim.—"I make no claim to securing the parts by a single bolt; but what I do claim as my invention, and desire to secure by letters patent, is the combination of the point, cutter, and mould-board, by means of the mortises in the point and the cutter, the tenon on the lower edge of the cutter, and the dovetail tenon on the land side of the mould-board, so as to unite them and render them more permanent and durable than ploughs now in use."

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20. For *Improvements in Smut Machines;* Joseph Johnson, Wilmington, Delaware, November 8.

Claim.—"Having thus fully described my improvement, I wish it to be understood that I do not claim as my invention the close cylinder, having projections thereon, nor do I claim constructing the concave with projections from its inner surface; but what I do claim as my invention, and desire to secure by letters patent, is the combination of a *close* cylinder, not admitting air at the ends, constructed, as above set forth, with a concave, having vertical projections thereon between the rows of holes in the said concave, in the manner and for the purposes herein described and in contradistinction to an *open* cylinder, with said projections combined.

"I also claim the fan, constructed in the manner described, with inclined heads to the case, for the purpose described, in combination with the smut machine, all arranged as herein set forth."

The fan is constructed in the usual manner, but the heads are inclined for the purpose of forming a reservoir of air at each end, one communicating with a vertical trunk which supplies air to the upper end of the fan, and the other with a separating trunk to clean the chaff and dirt.

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21. For *Improvements in the Machine for making Cultivator Teeth;* David B. Rogers, Stafford, New York, November 8.

In this machine the tooth is sweged between dies, and by the same operation the piece of iron, of the required form, is cut from a plate by combining with the dies cutters or shears which project beyond the surface of the dies, and which are so formed as to commence the cut in the middle of the plate.

Claim.—"Having thus fully described my improvement, what I claim therein as new, and desire to secure by letters patent, is the combination of the cutter or shears, projecting down in the centre, so as to commence cutting in the middle of the plate, with the die forming the teeth of the cultivator, substantially in the manner and for the purposes set forth."

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22. For an *Improved Illuminating Vault Cover;* Thaddeus Hyatt, New York, November 12.

Claim.—"Having thus fully described the nature of my improvements, in the illuminating vault cover, what I claim therein as new, and desire to secure by letters patent, is the combining with the covering plate a series of glasses of any suitable form, or of lenses; said

combination being effected substantially in the manner described, by the aid of laminæ of wood, or of soft metal, and the glasses or lenses being defended from injury by knobs, or protuberances, as herein set forth."

The glasses, which are conical, are let into wood, and the wood then secured to an iron frame with the large part of the glasses downwards, and their edges resting on the edges of the holes in the metal plate. Between each glass there is an iron projection to prevent the surface of the glasses from being scratched.

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23. For *Improvements in Machinery for making Barrels, Casks, &c.*; John Miner and Silas Merrick, Fallston, Pennsylvania, November 12.

We are under the necessity of omitting the claims, as they could not be understood without the drawings. The first section relates to the construction of two sets of arms on opposite ends of a shaft, each arm being provided with appropriate instruments for griping the staves to be presented to the action of a reciprocating plane. The second part is limited to the combination of parts employed in holding and presenting the staves to the crozing, &c. tools. And the third claim is limited to the arrangement of the saws (for jointing the staves), on inclined shafts, in combination with the carriage which carries the staves, and inclined planes or arms at each end which reverse the motion thereof and render the machine self-acting.

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24. For *Improvements in Machinery for Cutting Tenons;* James Briggs, New York, November 12.

The claims in this case could not be understood without the drawings, and we are therefore under the necessity of omitting them.

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25. For an *Improvement in the Cooking Stove;* R. Peck and J. W. Cochran, Attica, New York, November 12.

Claim.—"Having fully described our improvements, what we claim as new, and desire to secure by letters patent, is the combination of the variable fire-chamber with the boiler, constructed and arranged as described."

The front of the grate slides in and out horizontally, to vary the size of the fire chamber. The boilers are made with compartments which descend into the fire place, so as to extend the fire surface.

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26. For *Improvements in Locks for Safes, &c.;* Henry Isham, Montpelier, Vermont, November 12.

Claim.—"I do not claim the series of notched circular plates, &c., simply; but that which I do claim is the combination of the geared change wheels or plates, &c., with the said notched plates applied to them, and acting in connexion with them, and operated by an arber and tooth, or cam, or other mechanical equivalents, substantially in the manner as above described.

"I also claim the combination of mechanism by which the tongues or projections of the latch are kept from contact with their respective circular notched plates, when the main bolt is locked or thrown forward, the said combination consisting of the balance or fly wheel, chain, and spring, or other mechanical equivalents, the slide-plate, lever, (connected to the slide) and the slide, the whole being arranged and operated by the arbor and its tooth, substantially as above set forth."

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27. For a *Machine for Writing, called the "Chirographer;"* Charles Thurber, Norwich, Connecticut, November 18.

The patentee says,—"The nature of my invention consists in communicating to a pen or pencil holder, the motions necessary to delineate any and all letters or other characters, by motions at right angles to each other, obtained by sets of cams, each set being so formed as to combine the right angle movements, and thus generate the vertical, horizontal, oblique, and curved lines required to delineate the letters or characters. Each set of cams is actuated by a separate and distinct lever or handle, as in a piano forte, and the table with the paper, &c., caused to move forward the required distance at the termination of each letter or character by the return motion of the lever or handle.

Claim.—"Having pointed out the principle of my invention, and the manner of constructing and using the same, and indicated some of the variations in construction, which may be made without changing the principle or character which distinguishes it from all other things before known, what I claim as my invention, and desire to secure by letters patent, is communicating the motions to the pen or pencil by means of cams acting on frames, so that the vertical and horizontal strokes can be given by separate movements, and the oblique and curved strokes by the combined action of the two, substantially as herein described.

"And I also claim giving to the sheet of paper, or other substance to be written upon, a horizontal movement for spacing off the letters, and a vertical movement for the lines, in combination with the movements of the pen or pencil, substantially as herein described."

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28. For an *Improvement in the Bee Hive;* Christopher Suidam, Lambertville, New Jersey, November 18.

The inclined shelves are provided with tubes, along which the moth will pass, and these communicate with a space surrounding the drawers which are made double for that purpose.

Claim.—"Having thus fully described my improvements, what I claim therein as new, and which I desire to secure by letters patent, is the combination of tubes, as described, on the inclined planes, with the double shell of the drawer, in the manner and for the purposes set forth."

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29. For *Improvements in the Portable Forge;* Christian V. Queen, Peeksville, New York, November 18.

The forge is provided with shutters, which slide around to enclose the fire place when not in operation. The forge fan is provided with a pipe which communicates with the bellows, and from this pipe there is a branch provided with a valve, so that air can be admitted to the fire, when the bellows is not at work.

Claim.—"Having thus fully described the manner in which I construct my portable forge, and arrange the respective parts thereof, what I claim therein as new, and desire to secure by letters patent, is the combination of the curved sliding-shutters for enclosing the space over the fire, and the device for admitting a draught of air to keep up the combustion during the intervals in which the bellows are not employed; the same being effected for the purpose and substantially in the manner made known."

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30. For *Improvements in the Cooking Stove;* John Porter, Gettysburg, Pennsylvania, November 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination and arrangement of the fire chamber and roasting oven, having doors opening into the fire-chamber when direct radial heat is required in the oven.

I also claim the combination of the boiling apartment and baking-oven, constructed in the manner set forth."

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31. For an *Improvement in the Manufacture of Hat Bodies of Wool or Fur*; Marmaduke Osborne, New York, November 18.

Claim.—"Having thus described the nature of my improvement, in the manner of forming hat bodies of wool, fur, or other suitable material, what I claim as new therein, and desire to secure by letters patent, is the manner herein set forth of saving the labor of reblocking and of ironing such bodies, by interposing between them and the block a material to which resinous stiffening will not adhere, or to which, if it adhere, said material will not adhere to the block; by which device, in either case, the body may be allowed to dry upon the block, and may be removed therefrom in perfect form."

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32. For an *Improvement in the Trucks for Railroad Cars;* Levi B. Thyng, Lowell, Massachusetts, November 18.

The spring bolster rests at each end on springs suspended by shackles from the sides of the frames, to admit of easy play in all directions.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode, herein described, of hanging the car body, and governing its lateral motion; that is to say, the spring-bolster constructed and governed in its motions substantially as herein described, in combination with the springs and shackles; the whole being constructed and operating substantially as herein set forth."

33. For *Improvements in Machinery for Condensing and Laying Cotton Slivers;* John Tatham and David Cheetham, England, November 18.

The delivery apparatus is placed eccentric with respect to the centre or axis of the receiving cam, which is caused to revolve very slowly in the contrary direction to the delivery apparatus.

Claim.—"We claim the combination with a cam, or other mechanical equivalent of mechanism, substantially as set forth, for laying a sliver therein in eccentric helices, as above described; also the combination with the above of a corresponding frame or plate, disposed over it and operating so as to condense the material, or force it into the cam, as above specified."

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34. For *Improvements in Machinery for Manufacturing Shirred India Rubber Goods;* James Bogardus, New York, November 21.

The patentee says,—"The nature of my improvement consists, first in making the rollers between which the fabric is formed, of metal or other hard substance with their surfaces grooved in the direction of their periphery, to correspond with the number and size of the India rubber strips and the spaces between them, the strips passing in the grooves, and the two pieces of cloth being pressed together between them by the ridges, and the grooves being of such depth as to insure sufficient pressure to cause the pieces of cloth to adhere to the pieces of India rubber. And, secondly, in connecting the feed rollers, (which supply the strips of India rubber at a velocity less than the passage of the completed fabric between the grooved rollers to distend them), with the gearing which communicates the feeding motion by means of a ratchet to admit of turning back the feed rollers at the commencement of each operation, for the purpose of distending the strips between the feed rollers and the grooved pressure rollers."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method, herein described, of uniting the various parts in making shirred or corrugated India rubber fabrics, by passing the cloth and strips of India rubber between pressure-rollers, one or both of which is grooved in the manner described to receive the strips of India rubber, and make pressure on cloth between the strips, as herein described.

And I also claim connecting the driving feed roller with the gearing which drives it, by means of a ratchet, to admit of turning it back to stretch the strips of India rubber, when this is combined with pressure rollers, the peripheries of which move with greater velocity than that of the feed rollers, as herein described."

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35. For an *Improvement in the Method of Curing Smoky Chimnies;* John Plant, Washington, D. C., November 21.

Claim.—"Having fully described my improvements, what I claim as my invention, and desire to secure by letters patent, is, first, forming a recess in the breast of a chimney, over the arch of the fireplace, for the reception of external air, and delivering the same in a

thin stratum, as herein described, the whole width of the arch, in the manner and for the purposes above set forth.

I also claim gathering the throat of the flue, as above described, by curving out from the side that the flue is to be carried up on, and curving the other side up over it, as above specified."

36. For a *Machine for Slitting India Rubber;* James Bogardus, New York, November 21.

The patentee says,—"Instead of attaching the cutting wheels to the shafts permanently, they are put on by means of a feather so as to turn with the shafts and yet slide thereon freely; in this way the edges of the two series where they pass between each other, can be kept in close contact by the turning of a nut on the end of one of the shafts, for the turning of this nut must of necessity act on all the wheels of the two series.

I am aware that a series of cutters, or disks, have been secured on a shaft by means of a nut, and therefore I wish to be distinctly understood that I do not claim this as my invention; but what I do claim as my invention, and desire to secure by letters patent, is the method herein described of adjusting the cutter edges of two series of cutting wheels, which fit between each other, by having each series to slide endwise on a shaft, so that the edges of the two series can be forced into contact by a nut, wedge, spring, or other analogous device, as herein described.

37. For an *Improvement in Spindles for Spinning;* Alexander Anderson, Paterson, New Jersey, November 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is extending the tube below the traverse rail, in the manner and for the purpose set forth."

The object of extending the tube below the rail is the better to steady the spindle, and enable it to work steady at very high velocities. This is claimed as an improvement on the Gore tube, so called from the name of the inventor.

38. For an *Improvement in Pianos;* William T. Senior, New York, November 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the introduction of the arch in the middle of the bottom, whereby I am enabled to obtain great power of resisting the strain caused by the tension of the wire strings of the piano forte, besides other advantages in improving the qualities of the instrument by keeping the case always in shape, so that it cannot draw up or "wind," as is invariably the result in the present mode of manufacture, and consequently keeping the instrument in tune and order for a much longer period."

This improvement consists in so arranging the planks and timbers that the interior or middle layer shall form an arch springing from an abutment at each end, on the under side coming together at the

middle and joining at the top, thus applying that principle in obtaining increased strength and power of resistance.

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39. For an *Improvement in the Rotary Planing Machine;* Joseph E. Andrews, Boston, Massachusetts, November 21.

Instead of carrying the board to be planed to the rotating plane by means of feed and pressure rollers, as in the Woodworth machine, there is an endless belt of strips or slats on which the board is placed, and two similar belts, but shorter, above the board and pressed on to it. The motion of these belts feeds the board, the upper ones making pressure on it to prevent it from being lifted up by the action of the plane.

Claim—"Having thus fully described the manner in which I construct my planing and jointing machine, and shown how the respective parts thereof operate, what I claim therein as new, and desire to secure by letters patent, is the manner herein set forth of forming, arranging, and combining with the revolving cutter wheel, the revolving platform, and the endless aprons between which the board to be planed is to be passed; by means of which arrangement and combination it is firmly held along the whole length of such apron, and carried regularly forward, without deviation."

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40. For an *Improvement in Stoves;* Eli C. Robinson, Troy, New York, November 26.

Claim.—"What I claim, and desire to secure by letters patent, are the flue passages across the top of the stove for the fire and heated air, after the same have been made to pass round the oven, and up to the top of the flue in front of the fire-place, to be continued to the stove pipe, as above described."

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41. For an *Improvement in the Method of Letting down and Raising Propellers;* R. F. Loper, Philadelphia, Pennsylvania, November 26.

The patentee says,—"My invention consists in attaching two screws to cog wheels on the deck of the vessel, which mash into a large cog wheel on the drum of a capstan, the threads of the screws taking into nuts formed in the sliding frame of the propeller, the sides of which frame are bored out cylindrically to a certain depth, to admit the screws to pass therein, and to protect them from the action of the salt water deposits and rust, which would otherwise prevent their working."

Claim.—"What I claim as my invention and desire to secure by letters patent, is combining the elevating screws with the frame of the propeller, by means of openings therein to receive the same, so constructed as entirely to exclude the surrounding water from that part of the screws which is within the frame, the whole being constructed and arranged substantially as herein set forth."

42. For *Improvements in Water Wheels;* William Dripps, Coatsville, Pennsylvania, November 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the apertures in the wheel, for the introduction of the water to the buckets, to extend through the outer or cylindrical perimeter thereof, near the top, and then spirally down through, between the buckets, to the bottom thereof, in the manner described, in combination with the funnel-shaped inner rim and curved buckets, as set forth, whether the water be introduced from the inside or outside of the wheel, as before stated.

"I also claim the combination of the sliding frame, and segment valves connected therewith, by rods or stems of unequal lengths, for letting on the water by degrees, in the manner set forth."

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43. For an *Improvement in the Truss Frames of Bridges;* Nathaniel Rider, South Bridge, Massachusetts, November 26.

Claim.—"I claim the mode of producing the camber of the truss, viz: by the distension wedges, or apparatus, as above described, applied between the ends of the bars of the upper stringer, or chord, in *combination* with the contractile and cambering chain, made and applied to the lower or other suitable part of the truss, and operating substantially as above specified."

The wedges are applied at the junctions of the pieces composing the upper stringer of the arch, and below the arch there is a chain made in two parts, and connected by a swivel screw, for the purpose of shortening the chain which supports the arch.

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44. For an *Improved Method of Indicating the Height of Water in Steam Boilers;* George Faber, Canton, Ohio, November 26.

The patentee says,—"My invention consists simply in attaching a magnet to the axis of motion of a wheel or lever, to which the float is suspended or attached, to communicate motion by attraction and repulsion, to an index needle turning on an axis outside the boiler, and separated from the magnet by a steam-tight plate."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein described, or any other substantially the same, of indicating the rise and fall of water in a steam boiler or generator, by means of an indicator outside thereof, actuated by a magnet, connected with a float or any other body within the boiler, that rises and falls with the water, and connected with the magnet, substantially as herein described."

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45. For an *Improvement in the Steam Engine;* R. F. Loper, Philadelphia, Pennsylvania, November 26.

The patentee says,—"The nature of my invention consists in rotating two crank shafts with equal velocities, and in opposite directions, by means of a connecting rod, extending from the cross-head of a steam engine to the two crank shafts, the centre of vibration of the cross-head being centrally between them."

Claim.—" What I claim as my invention, and desire to secure by letters patent, is connecting the cross-head of a reciprocating engine with two crank shafts on opposite sides of, and at equal distances from the centre of vibration, by means of a connecting rod or lever turning on the cross-head, and reciprocating with it, and taking hold of the cranks on the two crank shafts, by which they are caused to turn in opposite directions, and with equal velocities, as herein described."

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46. For an *Improvement in Propelling Vessels;* Stephen R. Parkhurst, New York, November 26.

Claim.—" Having thus fully described my improvement, I wish to be understood that I do not claim as my invention the employment of a submerged horizontal wheel within a case in the vessel, as that has before been essayed; but what I do claim as my invention, and desire to secure by letters patent, is the case, above described, into which the propellers are inserted, to be placed on the outside of a vessel, of the usual form of sailing vessels, which is independent of and can be taken from said vessel, in combination with a series of horizontal propellers placed one before the other, in the manner set forth."

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47. For an *Improvement in Washing Machines;* Grey Utley, Chapel Hill, North Carolina, November 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of attaching pressers to the levers, by the rods and cords, so as to produce the effect stated."

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48. For an *Improvement in the Plough;* Patrick Gallagher, Chambersburg, Pennsylvania, November 26.

Claim.—" I do not claim adjusting the clevis with a screw and moving swivel hook, as in the " Gallatin plough;" but what I do claim as my invention and improvement, and which I desire to secure by letters patent, is the mode of raising and lowering and confining the ring against the inner side of the front or vertical part of the clevis, by means of a segment grooved wheel, or head, raised and lowered by a vertical screw turning in a female screw, in the upper or horizontal part of the clevis, by which combination and arrangement the weakening of the clevis, arising from the necessity of cutting the usual notches in it for holding the ring, is avoided, and the dropping of the ring is prevented; the said segment grooved wheel holding the ring against the front part of the clevis at the height desired, and made adjustable to any required level, for various depths of ploughing, as set forth."

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49. For a method of *Propelling Boats or Rail Road Cars;* Josephus Echols, Columbus, Georgia, November 26.

The patentee says,—" By placing the compensating wheel at the bow where the water must be displaced, the deflection of the water

communicates available power to the wheel which may be advantageously applied to aid in the propulsion of the boat, or applied to any other purpose."

Claim.—" Having thus described the principle of my invention, and the various modes in which I have contemplated its application, I wish it to be understood that I do not claim the propelling of boats, &c., by the reaction of issuing streams of water, when effected by steam or other power, on the boat, &c.; but what I do claim as my invention, and desire to secure by letters patent, is the method of propelling boats on canals, or cars on railroads, by means of a column or columns of water discharged from an upper level or reservoir (not moving with the boat) to a lower level, by means of a syphon or syphons, attached to and moving with the boat, or car, in manner substantially as herein described."

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50. For an *Improvement in Tailors' Measures;* Abm. A. Bogardus, Newbury, New York, November 29.

Claim.—" Having thus fully described my improvement, what I claim as my invention, and desire to secure by letters patent, is the combination of the scale of subdivided measures, and the protractor, in the manner described, so that the angles for laying out any sized coat shall be given by the protractor from the points found, by measuring the person to be fitted by means of the scale: as set forth."

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51. For an *Improvement in Stoves;* William Butcher, Philadelphia, Pennsylvania, November 29.

Claim.—" What I claim as my invention, and which I desire to secure by letters patent, is preventing the fire and ashes escaping from the stove through the draught openings, by dividing the base or lower box of the stove into a number of apartments, communicating with each other, formed by a horizontal perforated plate, and vertical perforated plates, in the manner and for the purpose set forth."

List of American Patents which issued in the month of April, 1842 *—with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

Continued from Page 319.

13. For *Improvements in Vinous Fermentation;* Charles C. Edday, Benton, Missouri, April 1.

The patentee says,—"The nature of my invention consists in bringing up the heavier portion of the grain, or fermentable matter from the bottom to the top, and conveying down the lighter or more fermentable matter from the top to the bottom, or suspending the heavier portion at the top, or at any point within the tub that may be desired, and carrying the lighter or more fermentable part of the fermentable matter to the bottom, or suspending it at any point within the tub at plea-

sure, and thus acting on every point alike at the same time until all has undergone thorough fermentation."

Claim. "What I claim in the foregoing, is, the mode of accelerating and perfecting vinous fermentation in close vessels herein set forth, that is to say, I claim the returning of the lighter and more fermentable matter which floats on the surface of the mash in the fermenting tun to the bottom of the same, and bringing up from the bottom to the top the heavier parts of the fermentable matter, and exposing it to the action of the gas, while it is emptied out of the buckets into the centre of the tub, and also the returning or forcing of the gas by means of force pumps, or any and all the modes herein set forth, and returning the gas as a ferment, and to all other purposes to which it may be converted, using the wheel with the buckets, or the cylinder with the gas, or any other mode herein set forth substantially the same, also the horizontal tub and the method of applying the steam through the hollow shaft for scalding the grain or fermentable material."

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14. For an *Improvement in Weavers' Temples*; Josiah Beard and Abram Whitney, Waltham, Massachusetts, April 6.

This is for the combination of the rotary and jaw temples, the latter being so situated that it gripes the cloth between the former and the reed, as the holding of the cloth between the reed and rotary temple presents the selvages in a better condition to the gripe of the jaw temple.

Claim.—"Having thus explained our invention, we shall claim the combination of the revolving and jaw temples arranged together as above described, and operating so that the selvage of the cloth, intervening between the reed and the revolving temple, shall be grasped and firmly held during the process of weaving, in manner, and for the purpose before set forth."

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15. For an *Improved method of fastening the Nibs on Scythe Snaths;* Thomas W. Harvey, of New York, assigned to Samuel Garfield, Senior, April 6.

Claim.—"Having thus fully described the nature of my invention, and shown the manner in which the same is carried into operation, it is to be understood that I do not claim to have invented either of the parts of the snath, nib or handle taken individually; but what I do claim is the particular manner in which I have combined these with each other, so as to form and constitute what I have denominated the double fastened nib: that is to say,

"I claim the employment of a bolt, which is furnished with a screw at each end, one end of which is to be screwed into the part of the ring and to bear upon the clip; the other end is to receive the nut after the handle has been placed thereon, thus forming the double fastening as set forth.

"I claim the foregoing in combination only, together with such variations thereof as are substantially the same in construction and operation."

16. For an *Improvement in Air-tight Stoves;* Zephaniah Bosworth, Marietta, Ohio, April 6.

We omit this claim, as it refers to, and could not be understood without, the drawings. It is limited to the combination of diving flues in the corners that extend from the upper part of the combustion chamber to a false bottom below, provided with an exit pipe that leads to the chimney, and a door to admit air, by means of which the draught can be regulated at pleasure.

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17. For an *Improvement in Bee Hives;* Shadrack Trumbull, Suffield, Connecticut, April 6.

Claim.—"What I claim as my invention and desire to secure by letters patent, is a new and useful improvement in bee hives, in the construction and arrangement of a box with two apartments, the largest of which is to receive boxes, the other for bees to ascend to the hive above, and at the base to communicate with the inner boxes. This box or hive is intended to accommodate old swarms, by placing the hive which contains the swarm above, and this beneath, which will furnish the bees with sufficient room at all times without injury to them or causing their destruction, as herein described."

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18. For *Improvements in the Corn Planter and Cultivator;* Samuel Brady, Salorne, Clinton County, Pennsylvania, April 6.

The claims in this case could not be exemplified without drawings, which would necessarily be complex.

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19. For a preparation for *Cleansing the head of Dandruff;* James Mackay, a British subject, now residing in New York, April 6.

"The following is the specification, viz:—The ingredients are as follows: the liquor from carrots, rum or spirits, sweet oil, and the oil of bergamot, the mode of preparing being in about the following proportions. To half a pint of liquor (which may or may not be clarified) in which half a pound of carrots has been boiled soft, add one gill of rum or spirits, half a gill of sweet oil, and twelve drops of the oil of bergamot; the above I claim as my invention, and desire to secure the same by letters patent."

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20. For *Improvements in the Harvesting Machine for Cutting, Thrashing, Winnowing, &c., Grain;* Charles Brown & Francis S. Crans, Barton, New York, April 6.

The patent is granted for an improvement in the method of discharging the grain from the teeth of the cutting part of the machine, which consists of a wheel with small scythes projecting from the wheel, with rake teeth ranged above each scythe to hold on to the grain, and the improvement consists in the peculiar arrangement of sets of teeth attached to the ends of levers, each set playing between each rake over the scythes, and these are so operated by a cam and segment, that as each rake passes by the place of deposite, the clearers are

moved out from the periphery of the wheel to the end of the rake teeth to discharge the grain, and then back for a repetition of the operation.

Claim.—" We do not claim as our invention merely discharging the grain from the teeth or rake by means of other fingers passing between them, as this has been done before by stationary fingers; but what we do claim as our invention, and desire to secure by letters patent, is the mode of discharging the grain from the rake by means of the movable discharger, operated by the cam and segment as herein described."

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21. For an *Improvement in the Extension Rocking Chair;* Charles L. Bauder, Utica, New York, April 6.

The seat of the chair slides in the frame, and is jointed to the back of the chair which is in like manner jointed to the upper part of the frame, so that in sliding forward the seat, the back is inclined—a support frame for a foot board slides in the seat so that it can be drawn out when desired to support the feet.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the combination of the sliding rest frame and seat, and the combination of the foot board and rest frame as before described."

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22. For an *Improvement in Spring Saddles;* David Irvin, Madison, Wisconsin Territory, April 11.

The cantle and pommel are united by two steel springs fitted to the horses back and the forward part of the cantle between the two springs is provided with a projection to which the webbing is attached.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the projection on the forward side of the cantle above its lower edge in the manner and for the purpose above described."

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23. For *Improvements in the Steam Engine;* William A. Lighthall, Albany, New York, April 11.

Claim.—" In the foregoing specification, I claim as my improvement in the steam engine,—First, the arrangement and disposition of the steam chests, side pipes, condenser, exhaust pipe, bed plate and air pump in combination with the cylinder lying horizontal upon the solid keelson or frame, said cylinder being in the hold of the vessel, below the deck beams. Second, the mode of working the valves whole and half stroke, by the combination of the eccentric wheel, eccentric hook and branch hook, the heart cam and cam hook, together with the hollow rock shaft, substantially as described, in combination with the cylinder in the aforesaid horizontal position."

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24. For an *Improvement in the Water Wheel;* William Lamb, Whitestown, New York, April 11.

Claim.—" What I claim as my invention, and desire to secure by letters patent, is the construction of water wheels designed to run

under water, with one, two, or more floats so placed in relation to the shaft and body of the wheel as to form a short transverse section of a screw of one, two, or more threads respectively—to be made of any suitable material, and of a shape that may be moulded and cast whole, or to be made of wood, or part of each—in combination with a coiled or scroll trunk, so made as to bring the water in contact with one side of the wheel, and conduct it around the wheel in the direction the wheel runs (except what is discharged in its passage) the trunk being diminished in size gradually by drawing in the side or sides, or by gradually raising the bottom, or both, so that the size of the trunk at any given point,shall be adapted to the quantity of water remaining undischarged at that point, in its passage around the wheel under the floats; said trunk to be made of metal or wood, or part of each, and of a size and form best adapted to the circumstances."

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25. For *Improvements in the Apparatus for the Resuscitation of Persons from Suspended Animation;* Edward Welchman, Cold Spring, New York, April 11.

The patentee says,—"The above resuscitating apparatus consists of a double bellows, placed one above the other, the inferior one is for the purpose of inflating the lungs, the superior one for withdrawing the air previously introduced, thereby preparing the lungs for another inflation. Both of the bellows are filled at the same time, and by the same movement; the inferior one with atmospheric or other air, the superior one with air from the lungs. Both are discharged at the same time, and by the same movement."

Claim.—"I do not claim as my invention, the use of a pair of bellows for inflating the lungs, but the combination of the two bellows; one for the purpose of inflating the lungs, and the other for extracting the same; and also the further combination of them with an apparatus for warming the air or airs introduced into the lungs.

"I do not claim the materials of which the apparatus is constructed as new, as they may be made of various materials, but the mode or manner of their arrangement."

(To be continued.)

FRANKLIN INSTITUTE.

Sixteenth Exhibition of American Manufactures, held in the city of Philadelphia, from the 20th to the 31st of October, inclusive, 1846, by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts.

Address by Owen Evans, Esq.,

Chairman of the Committee on Exhibitions. Delivered on announcing the Premiums awarded.

Ladies and Gentlemen.—With this evening closes the Sixteenth Exhibition of American Manufactures, held by the Franklin Institute.

We were desirous of presenting to you at this time, the report of the Committee on Exhibitions, but the reports of the judges in many departments, came in at so late an hour, that it was found impossible to collate them in a proper manner, to be read this evening. We will therefore only announce the premiums.

The very able address by Mr. Roberts last evening, embraced so much strong argument to prove the importance of the mechanic arts, that I shall say but little, and perhaps had better say nothing.

Much doubt has obtained in regard to the policy of holding an annual display of the product of American skill. It was thought by some that the manufacturers would tire of being appealed to so frequently as once a year, and that the exhibitions possess so much apparent monotony that they would lose their interest with the public, by being held too often.

If the holding of these exhibitions was merely a money making scheme, it would be proper to consider these things, and either open them only when they would probably prove profitable, or call in some other attractions to bring an influx of visiters; but the Franklin Institute of the State of Pennsylvania, was chartered for the promotion of the Mechanic Arts, and its purpose in holding the exhibitions is to furnish a view of the progress of the Mechanic Arts from year to year; to effect that object it opens these rooms every autumn, and admits nothing which does not legitimately come within its jurisdiction.

Notwithstanding the heavy call that was made on the manufacturers for the exhibition at Washington last summer, and the holding of another in New York of the same kind, at the same time that we were open, a walk through these rooms will prove that the object of the Institute is appreciated by the manufacturers.

Those who hold that the condition of the manufactures of a country is an index to its prosperity and freedom—that its resources are the pillars of its greatness, cannot fail to admit when they compare previous exhibitions with the present, and with manufactures abroad, that we not only occupy a proud position among nations, but that we are constantly and rapidly increasing in importance, in independence, and in fame. If we admit that the Arts have value, such an argument must prevail, because we cannot fix their boundary. We may speed or retard their growth, but when once introduced into a country like ours, it would be difficult to drive them out, even if it were desirable. It is true that fruits and roots will sustain life, a cave will shelter us from the inclemency of the seasons—and there is room yet in this country for those who fancy such a mode of living.

We desire to thank the manufacturers who have sent their wares—the gentlemen who assisted us in the arrangement of the exhibition and those who served as judges—a vast deal of labor was required and it has been freely furnished. While we acknowledge our obligations to the gentlemen who have assisted us, we own ourselves much indebted to the ladies. In regard to our company, we are fully conscious of the probability that very few gentlemen would visit us if no ladies were to be present. Last year we called upon their judgment officially, and then only in one department. Whether their de-

liberations were of value or not, is perhaps best answered by the fact, that we this year solicited and obtained their assistance on two committees of judges.

In submitting the award of the Committee on Exhibitions, it is proper to say that, by a rule of the Institute, the report of the judges cannot be altered without giving notice to the chairman of the Committee of Judges, whose report it is designed to modify. The general rules governing the committee, and the duties assumed by it were elaborately and distinctly explained by the chairman of the last exhibition in his address, and we deem it unnecessary to repeat them now.

We cannot do more this evening than simply announce the awards. Articles that are equal to what have received premiums at former exhibitions, and all goods that have received favorable notice by the judges—and these comprise a very long list, will be noticed properly in the general report. Depositors are requested to exercise patience, until the report is published which will be in a very few days.

It is a source of regret to the committee that so many meritorious articles came in too late for competition. The number of this class this year is unusually large. Some of the judges remarked when returning their reports that their catalogue of the articles entered in time for competition was very meagre, while the display in quality and quantity greatly exceeded that of any previous exhibitions. The rules and regulations for the government of the exhibition were extensively published through the newspapers and by circulars more than three months before opening, and every facility was afforded by the committee for the public to become familiar with them. To set the rules aside would cause such serious confusion that very few, aware of its extent, would be willing to encounter it.

Report of the Committee on Exhibitions.

The Sixteenth Exhibition of American Manufactures, held under the direction of this Committee by the Franklin Institute, has been brought to a close; and it is now proper that the committee should present a report concerning the manner in which the duties confided to them by the Institute have been discharged.

Notwithstanding the general publicity which was given by advertisements and circulars, with regard to the time of receiving goods for exhibition, the delay on the part of depositors was this year unusually great. The time limited for receiving goods for competition, expired at 10 o'clock on the morning of Tuesday, October 20th, at which time our tables were little more than half covered with goods, and the judges' lists, made up to that moment, included only the articles then actually in the rooms. The rule was rigidly enforced, though the doors were then thronged by a crowd of depositors, who, during Friday, Saturday, and Monday, had neglected to bring their goods, but were now, at the last moment, eagerly pressing forward, and clamorously demanding an entry on our books before the 10 o'clock line was drawn. Some of the most commendable articles in

the exhibition were thus brought too late for insertion on the lists furnished to the judges; and many depositors were thus deprived, by their own negligence, from receiving a merited award. To this delay of depositors may also be ascribed the cause why the premiums awarded this year are smaller in number than at the last exhibition.

The removal, since our last exhibition, of the Philadelphia Museum collection, with the cases in which it was contained, from the upper saloon and galleries, greatly extended the space to be occupied by us, and added about one-third to the capacity of our tables. This removal of the museum, and consequent extension of area, produced an impression on the first opening of the exhibition, that the collection of goods was much smaller in quantity than that of last year; but the entries on our books show a considerable increase in many of the departments, and towards the close of the first week, when the deposits were generally in, the total collection was not inferior, in extent or interest, to that of any former year.

In making our awards, and in our notices of the several articles deposited, we have been governed by the reports of the judges appointed to examine them. If injustice has been done to any depositor, or if any article which was brought *in time* has failed to receive due notice; the error must be ascribed to accidental or unavoidable omission, and not to intentional neglect. Where so vast an amount of labor as we have had to perform, falls upon so small a number as have this year taken an active or efficient part; it is not possible for human diligence and attention to prevent error, or omission, in particular cases.

The following general abstract is compiled from the reports of the judges in the several departments:

I.—*Cotton Goods.*

The display of cotton goods is much inferior, both in quantity and variety to that at the last exhibition. The judges report that the printed cottons give no evidence of any improvement, either in style or quality; and are decidedly inferior to those of last year. In the cotton fringe, checks, canton flannels, cotton yarns, Manchester ginghams, and cotton warp, they perceive no improvement whatever. The colored spools, made by J. L. & S. Shreve, though brought in too late for competition, deserve high commendation for style, color, strength, and finish. A case of goods from James' steam mill was also too late, but as far as the judges could determine by looking through the glass, (the case being fastened,) they appear to maintain their general character for superiority of style and fineness.

II.—*Woolen Goods*

No. 20, embroidered woolen shawls, made by Duncan & Cunningham, Belleville, N. J.,—No. 16, scarlet, blue and green blankets, by the Gonic Manufacturing Co., Rochester, Mass.,—No. 46, embossed table and piano covers, by Duncan & Cunningham, Belleville, N. J.,—No. 43, superfine black cloths, by W. & D. D. Farnum, Waterford, Mass., all deposited by David S. Brown & Co. The judges speak of

these goods in terms of high commendation, but do not consider them superior to the same description of goods for which the first premium has been awarded to their respective makers at former exhibitions.

No. 19, fancy cassimeres, by the New England Co., deposited by D. S. Brown & Co., for superior make and finish, are entitled to a
Second Premium.

Nos. 26, 26½, plain black and figured cassimeres, by Wethered & Bro. of Maryland, deposited by W. R. Hanson & Bro. These goods, for their superior style and finish, are considered worthy of a
Second Premium.

No. 50, black cloths, by S. Slater & Sons, Newburyport, Mass., deposited by W. R. Hanson & Bro. The piece-dyed specimens are regarded as a good article, and fully deserve a Second Premium.

No. 42, green cloths, by W. & D. D. Farnum, Waterford, Mass., deposited by D. S. Brown & Co., are of good make and color.
A Second Premium.

The judges also notice with praise Nos. 44 and 45, fancy and striped cassimeres, by W. & D. D. Farnum, Waterford, Mass., and No. 41, plaid cassimeres, from the Union Woolen Co., Providence, R. I., deposited by David S. Brown & Co.

III.—*Carpets and Oil Cloths.*

After a careful examination of the goods deposited in this department, the judges report that though the articles are generally creditable, they do not conceive themselves authorized to recommend any premium. They remark that the two pieces of oil cloth, No. 363, by A. M'Callum & Co., are specimens of excellent manufacture.

IV.—*Silk Goods and Gloves.*

No. 21, eleven pieces silk vesting, made by Campbell & Bro., Philadelphia. The judges consider these specimens of American manufacture equal to any imported, containing the same quantity of silk per yard, and worthy of a Second Premium.

No. 953, an invoice of silk goods, by J. S. Whitney, Philadelphia, are considered as superior articles of the kind. The silk suspenders are mentioned by the judges as being the best they have ever seen of American manufacture, and deserving of a Third Premium.

No. 956, kid gloves, by G. R. Corry, Philadelphia. These are judged to be the best of American manufacture that have yet been exhibited, and fully equal to any imported. Their softness, beauty of stitch, and general appearance are highly commended, and they are considered as meriting a First Premium.

No. 959, a case of gloves by J. R. Ashford, Philadelphia, are considered as a superior article, and entitled to a Second Premium.

The following articles are mentioned by the judges as entitled to creditable notice: No. 30, sewing silk, spool silk, and silk hose, by Miss A. E. Storer. No. 31, cleansed and restored kid gloves, by J. A. Miller & Co. No. 974, kid gloves, by Wm. Hawkins; and No. 989, buck gloves, by A. Cheapdell.

V.—*Iron and Steel.*

This interesting department of the exhibition was well filled with specimens, and the committee were gratified to observe the progress of this important branch of the productive industry of Pennsylvania so amply illustrated by a great variety of specimens from different parts of the state. The following is an abstract of the report of the judges, and the premiums recommended by them are awarded by the Committee on Exhibitions.

No. 1661, a lot of rolled iron, of assorted sizes, round, square and band iron, made by Smith, Thomas, and Ogden, at the Fair Mount Rolling Mill, Philadelphia, and deposited by Morris & Jones. This iron is so well rolled, and the quality so good throughout the lot, that it is judged worthy of a First Premium.

No 1513, fifteen bars of hammered iron, made at Weymouth, N. J., by Colwell & Co. This iron is well hammered, of very good quality, and more uniform than usual. It is stamped, as all bar iron ought to be, with the maker's name. To it is awarded a

Second Premium.

No. 1590, nine bars of hammered iron, made by James Sproul, deposited by W. L. Potts & Son. They are unequal in quality—some of them very good, and others inferior. The maker's name is not stamped.

No. 1524, nine bundles of slit rods, made by Valentine & Thomas, deposited by Isaac Miller. These are of good quality and very similar to those exhibited on former occasions.

No. 1661, plates of boiler iron, made by Forsyth & Co., of Chester Co., deposited by Morris & Jones, are of the good quality usually exhibited by them.

No. 1518, one bar of rail-road iron of the H pattern, deposited by Thomas Hunt. This appears to be made of good iron; but is not so smoothly rolled as some specimens exhibited by others last year. A little more experience on the part of the manufacturer may obviate this objection.

No. 1691, two flat bars of rail-road iron, with countersunk holes, made by Robbins & Verree, Kensington, are good bars, and well rolled.

No. 1710, five bars of heavy rail-road iron, varieties of the H pattern, rolled by P. Cooper at Trenton, N. J., some of them intended and made for the Camden and Amboy R. R. Co. These specimens are highly creditable, and had they been deposited by the prescribed time, would have received a first premium.

No. 1691, a bundle of spring steel, by Robbins & Verree, Kensington, is a fair article.

No. 1513, six samples of foundry pig iron, from Maria, Carbon, and Red Point furnaces; some made with charcoal and some with anthracite. These are deposited by Colwell & Co., and all appear to be good.

No. 1554, two samples of pig iron, made with anthracite coal, at Henry Clay Furnace, near Reading, Pennsylvania, deposited by Curtis & Hand. A good article.

No. 1620, pig iron, from J.V.R. Hunter, of Sally Ann Furnace, Berks Co., Pennsylvania, and No. 1621, pig iron from P. A. & S. Small, of Ashland Furnace, York Co., Pennsylvania, look very well. A small specimen of pig iron, from the Harrisburg Furnace, by Governor Porter, is of excellent quality. A lot of good pig iron, deposited by Morris and Jones, is not marked with the maker's name;—and some other specimens came in so late as not to be put upon the judges' list.

The committee are gratified with the display of iron castings generally, but regret the absence of hollow ware, which ought to have been exhibited. In some instances they cannot judge with certainty as to the degree of credit due to different individuals, as castings are sometimes deposited in the name of the fitter, and that of the founder is not given.

No. 1574, a lot of vases, chairs, settees, and umbrella stands of cast-iron, by Morris, Tasker & Morris, Philadelphia. The designs are good, and the execution shows a laudable desire to improve in this important branch of manufacture, in which the makers show a highly praiseworthy progress. They deserve a Second Premium.

No. 1663, articles of cast-iron, by Jordan L. Mott, of New York, deposited by Williams & Hinds. The iron stands for school-desks, and seats with backs for scholars, are neat and cheap, and worthy the attention of school directors. The iron revolving chairs are well contrived, and the design for garden vases is good. The bathing tub of cast iron is an excellent article. To this lot of castings we award a Second Premium.

The attention of the judges on iron and steel has been called to the *cast iron stoves;* as specimens of the progress now being made in the art of casting. They are of the opinion that many of the specimens deposited deserve great praise as castings; and that those by Atwood, Cole & Crane of Troy, N. Y., and those by W. P. Cresson of Philadelphia, are worthy of First Premiums for the *casting*, if they should not receive a similar award as *stoves* by the judges of stoves.

No. 1608, cast iron fronts for fire places, deposited by Weaver & Volkmar, are beautiful.

No. 1592, specimens of iron railing for cemetery lots, by Robert Wood, Philadelphia. The design and workmanship deserve praise; but the top is not in good taste. The garden settees of cast iron deposited by him are very good.

No. 1647, a case of sheet iron, made in imitation of the Russian, by James Wood & Son, accompanied by stove work made of the article. This manufacture maintains the high character for which it received a first premium on a former occasion.

Two pieces of sheet iron, *said to be made in imitation of the Russian,* were deposited by Joseph Richards. The judges were unable to distinguish them from the foreign article, and on calling upon the depositor for proof that they were of American manufacture, he declined giving any. The sheets of iron were immediately removed from the exhibition by the judges; and they feel that they would be wanting in their duty, if they did not characterize this conduct on the part of the depositor as highly reprehensible. By the regulations of

our exhibition, the judges have a right to call for proofs of origin whenever they have any doubts on the subject. The design and object of these exhibitions is the promotion of home industry, and it is a high offence against propriety for a depositor to bring into them any article which he is not prepared to prove to be of American Manufacture.

VI.—*Umbrellas.*

No. 28, a case of umbrella handles, made by J. Schwartz, Philadelphia, of good taste and beautiful workmanship. They merit a
Third Premium.

No. 32, parasols and umbrellas, by William A. Drown, made entirely of materials of Philadelphia manufacture, and fully equal to those for which the maker received a first premium at the last exhibition.

No. 37, umbrellas and parasols, by Asch & Pincus, made entirely of materials manufactured in Philadelphia. The parasols are remarkable for the extreme neatness of the sewing, and the goods are made in a style worthy of the deserved reputation of these manufacturers, who received a medal at the last exhibition.

VII.—*Lamps and Gas Fixtures.*

The display of articles in this line is highly creditable to the manufacturers. After a careful examination by the judges, they recommend, and the committee award, the following premiums.

To No. 1287, three chandeliers in *or molu* by Cornelius & Co., Philadelphia, believed to surpass any before exhibited in beauty of finish, is recommended a special premium of the *Gold Medal,* with the consent of the Institute.

No. 1315, a silver plated gas chandelier, by E. Whelan, Philadelphia, a
First Premium.

No. 1261, gas burners, by Charles Gefroerer, Philadelphia, a
Third Premium.

No. 1262, gas burners, by Joseph Saul, Holmesburg, Pennsylvania, a
Third Premium.

No. 1214, lard lamps, made by John W. Henry, Philadelphia, a
Third Premium.

No. 1302, pine oil lamps, by M. B. Dyott, Philadelphia a
Third Premium.

No. 1294, embossed paper lamp shades, by C. Y. Haines, Philadelphia, a
Third Premium.

VIII.—*Hardware and Cutlery.*

This department, as usual, is one of the finest in the exhibition, and exhibits a highly gratifying view of the continued improvement made by our enterprising manufacturers in this important branch of domestic industry and skill. Great credit is due to the Committee of Arrangement in this division of the exhibition, for their zeal, and the

good taste displayed by them in the arrangement of the articles. The judges, after a careful examination of the great variety of specimens submitted to them, report as follows:

No. 608, a case of mill saws, by Wm. Rowland, Philadelphia, These saws were carefully compared with other very excellent articles of the same description, and for their evenness and excellence of finish they are believed to be the best exhibited, and worthy of a First Premium.

No. 613, mill, circular, and hand saws, by Paul & Hicks, deposited by Cresson and Fisher, Philadelphia. These articles were critically examined and compared with the last mentioned, and though in some respects the large saws were not quite equal to the former, yet the good workmanship and general excellence of the whole fully entitle the makers to the award of a First Premium.

No. 629, chisels, hatchets, and other edge tools, by John C. Beatty, Springfield, Delaware Co., Pennsylvania. These goods rank among the very best of their description, and for general excellence of workmanship and very superior finish, merit the award of a First Premium.

No. 631, edge tools, chisels, hatchets, &c., by John Beatty, Springfield, Delaware Co., Pennsylvania, deposited by Thompson, Carr, & Co. These goods were elaborately examined by the judges, who recommend for good workmanship and excellent finish, a First Premium.

No. 665, wire rope, by John A. Roebling, Pittsburg, Pennsylvania. The excellent make of this article affords the Committee much satisfaction in its examination. As it is the application of iron to a comparatively new purpose, and is beautifully made, the judges and the committee award to the manufacturer a First Premium.

No. 713, four cards of bolts, by F. J Stanley, New Britain, Conn., deposited by Heaton & Denckla. These appear to be, in all respects, substantial, neatly made, and well finished. The judges esteem them as surpassing in excellence anything of the kind heretofore deposited in our exhibitions, and fully entitled to the award of a First Premium.

No. 722, samples of locks, made and deposited by Morgan & Abell, Springfield, Mass. These locks are of simple contrivance and appear to possess all the elements of durability; they are also remarkably well made and finished. To the makers is adjudged a First Premium.

No. 611, a case of guns, by John Krider, Philadelphia. These guns, for good taste, workmanship, and finish, are believed to be the best ever exhibited, and entitled to a First Premium.

No. 616, watchmakers' tools, by L. Fabier, Lewisville, Ohio, deposited by L. R. Sowers, Philadelphia. Some of these articles are a close imitation of the best description of similar Lancashire goods; and it is believed that a little more practice will enable the manufacturer to compete successfully with the foreign article. For their general excellence they are deserving of a Second Premium.

No. 699, rifles, by E. K. Tryon, Philadelphia. These are very creditable goods, especially a specimen of rifles, made for the U. S. government. This sample is substantially and neatly made, and finished in excellent taste. These qualities, in connexion with the price at which they are furnished, entitle the maker to a

Second Premium.

No. 602, curry combs, by Wm. Wheeler & Co. Troy, N. Y., deposited by Price, Newlin & Co. A well made and serviceable article, worthy of a Third Premium.

No. 620, stocks and dies, by B. Martins, Philadelphia. Well made goods, designed and finished more for use than show, and highly creditable to the maker. They merit a Third Premium.

No. 637, Britannia spoons, by Foote & Co., Wallingford, Conn. Very creditable to the makers, and worthy of a Third Premium.

No. 640, shovels and tongs, by J. B. Byrne & Co., Trenton, N. J., deposited by Thompson, Carr & Co. A fair merchantable article for ordinary use, to which we award a Third Premium.

No. 680, axes, by Wm. Mann, Lewistown, Pennsylvania, deposited by Martin Buehler & Bro. These are beautifully made, and will compare advantageously with similar goods by our best manufacturers. They merit a Third Premium.

No. 703, a lot of planes, by Geo. Burnham jr., Amherst, Mass., deposited by Heaton & Denckla. These are in every respect the best made articles of the kind in the exhibition, and are furnished with irons of American make. They are not, however, superior either in make or finish to similar articles formerly exhibited. We award them a

Third Premium.

No. 704, scythes, by Inman & Co., Smithfield, Slatersville, R. I., deposited by Heaton & Denckla. An excellent article, well ground and finished, and entitled to a Third Premium.

No. 630, butt hinges, by Roy & Co., Watervliet, N. Y., deposited by Thompson, Carr & Co. The excellence of these articles fully sustains the just reputation of the makers; they are fully equal in every respect to those for which their manufacturers received a first premium at a former exhibition.

No. 657, planes, by Colton & Sheneman, Philadelphia, well made, but not quite equal in finish to similar articles formerly exhibited.

No. 658, screw wrenches, by S. Merrick, Springfield, Mass., deposited by G. H. Whitaker. A well made, substantial article, fully equal to any exhibited by the makers on former occasions.

No. 659, files, by Geo. Machin, Phila., worthy of the credit acquired by the maker at former exhibitions.

No. 666, wood screws, by the New England Screw Co., Providence, R. I., deposited by Curtis & Hand. These specimens are fully equal to those for which the makers have heretofore obtained the First Premium.

No. 991, Gilt buttons, by Wadhams & Co., Wolcottville, Conn., deposited by S. Byerly & Co. The makers of these articles received a premium on a former occasion, and the excellence of their present samples fully sustains their reputation.

The following articles are noticed by the judges in terms of commendation, and as deserving of attention.

No. 605, patent balances by David T. Stewart, Phila. 607, sash locks, by James Jones, Rochester, N. Y., deposited by Dilworth & Branson. 621, shovels, by T. C. Wood, Phila.: 632, scythe stones by F. & H. Keyes, Newbury, Vt., deposited by Steinmetz & Justice. 643, Britannia ware, by Hall, Boardman & Co., Phila.: These goods, are well finished; but the judges think would give greater satisfaction if more attention were paid to gracefulness of form. 646, shoemaker's awls, by Tho. Hall, Phila.: A fair article; but a better finish would add to the reputation of the maker. 647, shovels, by John Richards & Son, Phila. 650, brass goods, by F. Jordan, Phila., creditable; but will admit of better finish. 654, hammers, by B. Richardson & Son, Phila. 660, hoes, by Jacob Souder, Phila. 668, shoe knives, by John Ames, Mass., deposited by Curtis & Hand; worthy of special notice. 669, cast iron parallel vices, by Charles Parker, Meriden, Conn., deposited by Curtis & Hand. A substantial, well made article, highly approved. 672, planes, by E. W. Carpenter, Lancaster, Penna. 679, augers, by Thomas Slack, Chester Co., Penna., deposited by Martin Buehler & Bro. 682½, locks, by Joseph Nock, Phila. 683, shutter hinges, by Charles Parker, Meriden, Conn., deposited by Dilworth & Branson. 684, hand saws, by Bringhurst & Kirby, Germantown, Penna. 688, planes, by John Colton, Phila. 701, butcher and shoe knives, by J. Russell & Co., Greenfield, Mass., deposited by Heaton & Denckla. 702, hand cards for cotton and wool, by W. Whittemore, Boston, Mass., deposited by Heaton & Denckla. 705, butt hinges, by the New England Butt Co., Providence, R. I. 707, table knives and forks, by Geo. Bartholomew, Bristol, R. I., both deposited by Heaton & Denckla. 368, a cross bolt lock and knobs, by James F. Bradford, Phila., of very good workmanship.

No. 670, cast iron parallel vices, by Fisher & Martin, Newport, Maine, deposited by Curtis & Hand. These are a substantial, well made article. As the principal merit claimed for them is the mode of uniting the steel to the cast iron, and the adjustment of the jaws, the maker is recommended to apply for an investigation by the Committee of the Institute on Science and the Arts.

As usual, many excellent articles were brought too late for entry on the lists furnished to the judges. Among these may be mentioned No. 740, samples of locks manufactured in Charleston, S. C., by George Oates. 737, excellent locks, by Littlefield: and No. 1716, a stand of hoes, pitchforks and other agricultural implements, by E. & T. Fairbanks, deposited by D. O. Prouty, the finest exhibited, and worthy of the highest approbation.

IX.—*Saddlery, Harness, and Trunks.*

The judges appointed to examine this department of the exhibition recommend the following awards.

No. 374, two sets fine coach harness, by Lacy & Phillips, Phila. These sets differ from each other in style, but are of equal excellence in workmanship; presenting specimens of the highest order of skill

and taste on the part of the makers. They are deserving of a
First Premium.

No. 367, a set of single harness, by Mahlon Warne, Phila. This is highly commended by the judges for good workmanship, and merits a
Second Premium.

No. 349, two trunks, by John Unruh, Phila. Both excellent articles, and highly creditable to the maker. For the russet trunk we award a
First Premium.

No. 354, a russet trunk, by Thomas W. Mattson, Phila., is considered as well deserving a
Second Premium.

No. 380, valise trunk, by Jacob Moyer, Phila., a
Second Premium.

No. 365, a trunk, by W. P. Taylor, appears to be an excellent article; but being fastened, the judges were prevented from examining the interior. Other trunks were exhibited under similar circumstances.

No. 342, fly nets, by Aug. Miller, Phila. No. 370, a saddle, by M. J. Lukens. No. 382, saddles, by Wm. Moyer, are mentioned as articles of creditable workmanship.

X.—*Models and Machinery.*

The number and variety of articles in this important branch of the exhibition is superior to what has been seen in past years; but is still inferior to what it should or might be, in a city which may be termed the very seat of the mechanic arts. The display of working machinery exceeds that of several former exhibitions, and is thus far a subject of congratulation. We would, however, earnestly urge early and active attention on the part of the committee having charge of this department in future exhibitions; as it is one of the most interesting to visiters, and important to the community.

The following abstract is presented from the report of the judges on this branch.

No. 1501, A coal screen, by J. B. Wickersham, Philadelphia. An exceedingly well made article, which merits particular commendation, and to which we adjudge a
Second Premium.

Nos. 1511, 1523, and 1693, hydraulic rams, by H. P. M. Birkinbine & C. Farnham of Philadelphia, and B. S. Benson of Baltimore. The rams of Birkinbine and Benson were kept in operation in the lower room, and played an important part in the exhibition; to all appearance working effectually and satisfactorily. In Benson's arrangement means are afforded for throwing up spring, or other water than that which gives the lifting power; the operation of which was satisfactorily exhibited. This mode is claimed by him, and is an important modification where pure water is required. The judges had not the means, in the room, of testing the relative merit of these machines, and are consequently unable to make an award of premiums. They therefore recommend that the makers submit these articles to a special examination by the Committee of the Institute on Science and the Arts, in order to test the power and comparative merits of these useful contrivances for raising water.

No. 1512, machine for shaving stereotype plates, by C. H. Brightly, Philadelphia, well contrived, neatly made, and worthy of a Third Premium.

No. 1514, bricks burnt with anthracite coal, by J. W. Andrews, Norristown. Compact, well burnt, and of superior appearance; affording another evidence of the important employment of the great Pennsylvania staple in the useful arts. They deserve a Second Premium.

No. 1515, a copying press, by Charles Evans, Philadelphia, worthy of the well known reputation of the manufacturer.

No. 1527, a car coupling, by S. K. Sweetman, Philadelphia, which appears to have considerable merit. The judges recommend an application to the Committee on Science and the Arts for an examination.

Nos. 1529, 1530, 1531, portable mills, by Charles Ross, New York, deposited by Charles Greene, Philadelphia. These articles received favorable notice and a premium at the last exhibition; being highly approved for pioneer and emigrant uses in a new country. Several improvements having been made in these useful machines, we award, for said improvements, a Third Premium.

No. 1532, a cast iron mill for crushing and grinding corn and cobs, by J. P. Ross, Lewisburg, Union county, Pennsylvania. For this useful and important agricultural implement, which may be easily worked by horse power, we award a Second Premium.

No. 1537, power loom, by the Gloucester Machine Company. A well finished and effective article, which was kept in operation during the exhibition, a First Premium.

No. 1539, diaphragm water filters, by W. H. Jennison, New York, were sufficiently well noticed last year.

No. 1541, platform scales, by Ellicott & Abbot, Philadelphia. One of these is finished in remarkably neat style, and all appear to be well constructed and worthy of commendation.

No. 1544, carpenter's tool chest, by Thomas Little, a journeyman house carpenter. A very neat, pretty, and convenient article, deserving a Third Premium.

No, 1546, weavers' shuttles, by Isaac Senneff, Philadelphia, well made and finished, entitling the manufacturer to a Third Premium.

No. 1549. a machine for covering buttons, by Alonzo Isbell, Philadelphia. This machine was kept in operation at intervals during the exhibition, and excited much attention on account of the quiet and mysterious celerity with which it puts together the parts of covered buttons. It is judged worthy of a Second Premium.

No. 1550, Dr. Ross' exercising swing, made by G. W. Porter & Co., Philadelphia. This article was last year recommended to the Committee on Science and the Arts. The judges, in evidence of their confidence in its utility and safety, now recommend a Third Premium.

Nos. 1558 to 1565, a lot of agricultural implements deposited by D. O. Prouty, Philadelphia, consisting of grain fan, corn shellers, straw cutter, sausage meat cutter, hand grindstone, and ploughs. These all appear to be excellent articles, well adapted to the various purposes for which they are intended. To the grain fan, patent of J.

T. Grant & Co., Scaghticoke, New York, the judges award a Third Premium. The sausage cutter, so far as they can judge by inspection, will do its work well, on which ground they recommend for it a
Third Premium.

No. 1566, fire bricks, by Edward David, Trenton, New Jersey. The exhibitor desires to have these bricks tried; but it is well known that no trial can be made, with a result to be relied upon, with less than a quantity sufficient for a furnace; in which case only can their comparative merit be ascertained.

No. 1585, an "improved" cast iron water wheel, by Wm. Dripps, Coatesville, Pennsylvania; and No. 1594, model of an anthracite furnace, by C. Custer, Perry County, Pennsylvania, an application is recommended to be made to the Committee on Science and the Arts for examination.

No. 1606, an ingrain carpet machine, by John Scott, Philadelphia, is the best for workmanship which has fallen under the notice of the judges, who recommend for it a Third Premium.

No. 1607, a coverlet machine, by James Scott, Philadelphia. Worthy of the same notice as the last mentioned article, and deserving a
Third Premium.

No. 1613, weavers' shuttles, by Ellis Jackson, Philadelphia, a
Third Premium.

No. 1635, a patent blower, by J. Kisterbock, (Dimpfel's patent) of good construction, to which is awarded a Third Premium.

No. 1645, platform and counter scales, by E. & T. Fairbanks, Vermont, deposited by A. B. Norris, which sustain the deserved reputation of the makers.

No. 1657, Turbine water wheel, by H. Munger, Massachusetts. Application is recommended to be made to the Committee on Science and the Arts for examination.

No. 1670, a smut machine, by Leech Tyson, Philadelphia. A similar application is advised.

No. 1672, rolling pivot blinds, by John Bower, Philadelphia, are very creditable specimens of workmanship, and merit a
Third Premium.

No. 1673, axletrees, by J. H. Amer, Philadelphia, well made, and worthy of a Third Premium.

No. 1674, a mortising machine, by J. Cubbison, Philadelphia, for the chisels of which is adjudged a Third Premium.

No. 1631, model of a steam engine, by C. F. Carpenter, Chester county, Pennsylvania. This very neat and delicately constructed model is highly spoken of by the judges, as being of better proportions and execution than is usual in models. It merits a
Third Premium.

No. ——, the horizontal steam engine made by William Smith of Philadelphia, which was used to supply motive power for the various machines in operation during the exhibition, has proved very efficient and serviceable. It is neat in form, well proportioned, and exhibits good workmanship on the part of the maker. The judges recommend to him the award of a Second Premium; and the thanks of the

committee are due to the maker for his kindness in giving them the use of the engine.

No. 1553, models of trellis railway track, patented by James Herron, Civil Engineer, Philadelphia, and deposited by him. These models are very neatly made. They represent modifications of Mr. Herron's plans for constructing the superstructure of railways, which have been found in practice to work well, and which have been favorably reported upon by the Committee of the Institute on Science and the Arts several years since.

For an examination and report on the improvements in these tracks an application to the Committee on Science and the Arts is recommended.

A great number of articles were deposited after 10 o'clock on Tuesday, and were in consequence too late to be placed on the list furnished to the judges.

Among these is a neat and well made drilling machine, by Marshall & Teal, which would have received a premium if deposited in time. A portable forge, by C. H. Brightly, merits commendation. Welded gas pipes, by Morris, Tasker & Morris sustain the deserved reputation of the makers; and samples of the same article by S. Griffiths also deserve commendation. No. 1709, a card press by S. B. Ruggles, deposited by S. P. Seaman, the maker is recommended to apply for an examination by the Committee on Science and the Arts.

No. 1698, cast iron roofing, by William Beach, Philadelphia. This roof presents a neat appearance, and the casting is creditable. The article is deserving of attention, and should be effectually tried, by which alone the merit of the form and structure can be proved. Of the efficiency of the material there can be no doubt. Had this article been deposited in time it would have received a premium.

No.—a fillet card machine, by James Smith & Co., Philadelphia. This machine was occasionally in operation during the exhibition, performing its complex, manifold, and extraordinary motions with beautiful regularity and certainty. The filleting made by it is regularly stuck, and the wire teeth evenly cut. The machine is well made, compact, and neat in form, and is recommended to favorable consideration.

No.—, steam hammer, made and deposited by Merrick & Towne, Philadelphia. This highly important machine, by Nasmyth, of which Messrs. M. & T. hold the patent in this country, is of great value to the arts, and cannot be too highly recommended. The makers being both officers of the Institute, are precluded by our regulations from receiving any award; but the judges remark that under other circumstances, our highest premium would but faintly express their estimate of the value of this machine.

XI.—*Stoves and Grates.*

This branch of our exhibition is usually well filled with specimens, and the display this year, in quantity, variety, and excellence, is not inferior to that exhibited on former occasions. After a minute and careful examination, the judges report in substance as follows:

No. 1502, air tight cook-stoves, for coal, with brick ovens, made by R. D. Granger, of Albany, N. Y., deposited by North & Harrison, are judged worthy of a Third Premium.

No. 1503, cook-stove, for coal, by P. P. Stewart, Troy, N. Y., deposited by North & Harrison. This stove received a first premium at the last exhibition.

No. 1504, Parlor cook-stove, by R. D. Granger, Albany, N.Y., deposited by North & Harrison. The judges deem this an improvement on the general form of parlor cook-stoves, and recommend for it a Second Premium.

No. 1519, hot air cook-stove, by F. W. Most, Philadelphia. A plain and excellent article, worthy of commendation.

No. 1520, a boiler, for range, by R. S. R. Andrews, Philadelphia. A good article, of excellent workmanship, for which is recommended a Second Premium.

No. 1521, cooking range, by Julius Fink, Philadelphia, is the same for which he last year received a first premium. Pipes for the circulation of hot water have since been added, which the judges regard as a commendable improvement.

No. 1548, "anti gas oven," by Wm. Butcher, Philadelphia. The judges regard this as the best article of the kind they have ever seen, and recommend a Second Premium.

No. 1551 & 1552, cast and sheet iron radiator stoves, by S. J. Cresswell. Good specimens of workmanship, and entitled to a Third Premium,

No. 1569, Hedenberg's air-tight parlor coal stove; and 1617, Atwood's empire cook, both received premiums at the last exhibition.

Nos. 1575,—6 & 7, stoves by Atwood, Cole, and Crane, Troy, N. Y., deposited by F. P. Wagner, have been noticed by the judges on iron and steel, for the excellence of the castings.

No. 1603, arch radiators, by H. G. Bartle, Philadelphia, are articles of excellent workmanship, worthy of a Third Premium.

No. 1605, cook, radiator, and other stoves, by Foering & Thudium, Philadelphia. For the display and general excellence of these stoves, the Committee award a Second Premium.

No. 1608, stoves, grates, &c., by Weaver & Volkmar, Philadelphia. A fine assortment of useful and well made articles, worthy of a Second Premium.

No. 1609, grates, by Lloyd & Co., Philadelphia. These are said to be "enamelled," but the judges disapprove of the use of such a name when applied to a material having none of the properties of enamel.

No. 1611, tubular cook stove, by Jordan L. Mott, N. Y., deposited by Williams & Hinds, Philadelphia. A similar stove to that which last year received the first premium. Since that time the maker has improved it by the introduction of a brick oven; an improvement which the judges deem worthy of a Third Premium.

No. 1627, a parlor air-tight coal stove, with radiating flues, by by E. Ripley, Troy, N. Y. A durable and excellent stove; worthy of a Third Premium.

No. 1637, air tight cook stove, by Wager & Dater, Troy, N. Y., deposited by J. Kisterbock. Similar to one from the same makers which received a premium last year.

No. 1650, cast iron stoves, by Wm. P. Cresson, Philadelphia. Beautiful castings, and referred to by the judges on iron and steel.

No. 1664½, portable range, with revolving plate, by Jordan L. Mott, N. Y., deposited by Williams & Hinds. This range has the same mode of circulating hot water, as that noticed in No. 1521, and the Committee award to it a Third Premium.

No. 1547, hot air furnace, by Danl. Culver, Hartford, Conn. This furnace is compact, and at the same time presents a large radiating surface.

No. 1636, cook stove, by J. Kisterbock, Philadelphia. This stove received a premium at the last exhibition. It still maintains a favorable rank in the estimation of many who have used it.

No. 1690, cook stove, by P. F. Hagar, Philadelphia. A plain, serviceable, and good stove, which was entered too late, though the maker avers it was brought in time. If in time, the judges deem it worthy of a Third Premium.

The judges notice with approbation, No. 1555, cast iron parlor stoves, by Wager & Dater, Troy, N. Y., and similar articles by Atwood, Cole, and Crane, of the same place; as well as 1618, a fancy air-tight parlor stove, by Ransom, Albany, N. Y.

Good sheet iron radiators, &c., were deposited by Williams & Hinds, J. B. Kohler, and others, too late for competition.

XII.—*Cabinet Ware.*

It is remarkable that in a city so celebrated as Philadelphia for the amount, variety, and excellence of the furniture manufactured within it, so small a quantity should be offered for display at our exhibitions. We have no doubt that there are many establishments in the city, any one of which could furnish from its ware rooms, almost without being missed, an assortment equal in extent to the whole amount of cabinet work deposited in the present exhibition.

The judges in this department recommend the following awards.

Nos. 7 & 9, fancy reed blinds, by Martin Free, Philadelphia, of economical construction, well suited for the use of persons of limited means; a Third Premium.

No. 1220, five window shades, by Charles Duchesne, Philadelphia. These shades are magnificently ornamented; being painted upon a ground which is well and durably prepared, with excellent taste and artistic effect. They are immeasurably superior to any thing of the kind hitherto offered to the public in this country, and are eminently deserving of a First Premium.

No. 1221, fancy chairs, by A. McDonough, Philadelphia. A fine variety of light and well made chairs, all of which are worthy of commendation. To the rattan chairs we award a Third Premium.

No. 1228, three desks, by Amos Palmer, Philadelphia, of appropriate design and beautiful material, are considered worthy of a Third Premium.

No. 1265, a work box, by Joseph Weller, Philadelphia, for excellence of workmanship, deserves a Third Premium.

No. 1276, a Venetian blind, by W. B. Barnes, Philadelphia, is well made in all respects, and tastefully as well as richly got up. For it we cheerfully award a Second Premium.

No. 1286, a very richly ornamented gilt frame, by Jos. D. Williamson, Philadelphia. This article shows excellent workmanship, and merits a Second Premium.

No. 393, Venetian blinds, by B. & J. Williams, Philadelphia, are in excellent taste and perfectly well made. Their makers are entitled to a Second Premium.

No. 910, a centre table, by Albert Lindsay, deposited by Geo. J. Henkel, is very ingeniously contrived for convenient extension as a dining table, or by separation, for two pier tables. For this very ingenious and ornamental piece of furniture, the Committee award a Second Premium.

No. 1246, samples of furniture, by J. & A. Crout, Philadelphia. This furniture, made from various native woods, sustains the high reputation already acquired by the manufacturers. The dressing bureau is specially recommended to notice as a specimen of stained wood, with the award of a Third Premium.

No. 1298, specimens of wire gauze for window shades, by John Waters, neatly ornamented; and No. 1326, specimens of wood, ornamented by a new process invented by Richard Parkin, would have received premiums if they had been deposited in time.

The judges speak in terms of commendation of No. 1232, a well made pedestal of walnut wood, by J. Henkel; and No.—, a sofa table of ailanthus wood.

XIII.—*Musical Instruments.*

No. 619, an eight-keyed flute, by Geo. Catlin, Philadelphia. This instrument presents nothing new; but its quality of tone is so good, that it is deserving of a Third Premium.

No. 1211, flutes, by J. Pfaff, Philadelphia. The finish and tone of these instruments are such as to merit the highest praise. The maker received a first premium last year for similar articles.

No. 1222, a piano, by Geo. Hupmann, Baltimore.—The tone of this piano is very good: the style of its mechanism is old fashioned: it is, however, deserving of a Third Premium.

No. 1242, a violin, by Samuel Phillippe, Easton, Penna. This violin is pronounced by competent judges to be of excellent quality, and will improve with age. This being a new branch of manufacture, and the finish and quality of this instrument so good, the judges recommend the award of a First Premium.

No. 1273, guitars, by C. F. Martin, Nazareth, Penna. These guitars are of surpassing excellence, both as regards tone and workmanship. Imported guitars would suffer in comparison with them. They are considered fully equal to those for which the maker received a first premium at the last exhibition.

No. 1275, two pianos, by J. H. Schomacker & Co., Philadelphia.

No. 1 has a fine, full, and even tone; the mechanism of the keys is very accurate. The contrivance for candlesticks behind or under the music stand is regarded by the judges as ingenious; but they recommend that it should not be used, as it is better to avoid adding any thing to a piano which might cause a jarring or vibration in the instrument. The judges regard these pianos as creditable to the reputation of the makers, and fully equal to those for which they received a first premium last year.

No. 1283, three pianos, by C. Meyer, Philadelphia. These are regarded by the judges as very good instruments; one of them superior to those sent last year by the same maker, for which he received a first premium. On account of this improvement, the committee now award him a First Premium

No. 1295, a case of musical instruments, by Tho. J. Weygandt, Philadelphia. These instruments are very creditable to the maker. Their tone is particularly adapted for an orchestra, being very full and rich. To them is awarded a First Premium.

Several good instruments came in too late, which otherwise would have received premiums. Among these are No. 1317, a valve trumpet, by C. Zoebish & Son, Nazareth, Penna., and No. 1301, a piano, by Thomas Loud.

XIV.—*Glass and Earthenware.*

The judges on glass and earthenware notice that the contributions to this department of the exhibition are more varied than usual, and, except in fine cut glass, the goods are superior of their kind.

No. 609, cut glass, by the Brooklyn Glass Co., deposited by Filley & Walker. The cutting and finish of the flint glass deserves great praise: the material is good, but not equal to some formerly produced by the same makers. The large druggists' jars are very beautiful, and merit the award of a Second Premium.

No. 610, glass bending, by James Mason, Philadelphia, is a new article in our exhibitions, and deserves much praise. We award for it a Third Premium.

No. 612, earthenware, by Bennett & Bros., Birmingham, Penna., deposited by Geo. Hamersly, Philadelphia. The makers received a second premium at our last exhibition; but the present samples show a great improvement over the excellent ware exhibited by them last year. The large water jar is equal to the best ever produced from the English potteries. The makers are entitled to a First Premium.

No. 644, glassware, by Capewell & Bros., Philadelphia. This is chiefly intended for chemical purposes, and is very creditable to the manufacturers.

No. 645, druggists' glassware, by Burgin & Pearsall, Philadelphia. The perfumers' bottles are very good; the other glass a fair article.

No. 677, coated and colored glass, by the Boston and Sandwich Co., deposited by Thomas Hartell. A premium was awarded to the makers for the same description of glass at a former exhibition. The colors are better in these samples; but the improvement appears to be due to the quality of the glass.

No. 691, Green Glass, by Benners, Smith, and Campbell, Philadelphia. These are very superior goods throughout the lot, and merit a Second Premium.

No. 692, a small lot of earthenware, by R. B. Beach, Philadelphia, deposited by E. B. Jackson. A good article,—well finished,—and worthy of a Third Premium.

No. 915, tobacco pipes, by Morgan & Richards, Kensington, a good and well made article, to which we award a Third Premium.

XV.—*Books and Stationery.*

From the notes of the judges in this department, we compile the following awards and remarks.

No. 14, bookbinders tools and dies, by Gaskill & Copper, Philadelphia. These makers are acknowledged leaders in this business, and the present specimens are worthy of their reputation. We award them a Third Premium.

No. 25, law sheep, and plain and sprinkled sheep bookbinding, executed in a superior manner, by Lindsay & Blakiston, Philadelphia. Though such work as this is not fashionable on a lady's centre table, it is of great importance to the student and professional man. It deserves a Third Premium.

Specimens of extra work, by the same binders, are highly commended by the judges.

No. 34, blank books, by Speel & Donohue. The ruling is neat- and the work strongly and tastefully executed.

No. 54, velvet binding, by J. B. Lippincott & Co. Executed neatly, in great taste and variety of style,—worthy of a Third Premium.

The judges also notice favorably Nos. 58 and 59, paper from the Southworth Manufacturing Co. They further report that the ink deposited by Harrison last year was tried by one of them, and they embrace this occasion to commend its good qualities as a writing ink.

XVI.—*Paper Hangings.*

The judges report that they notice with pleasure the great improvement in the manufacture of Paper Hangings, and say that they do not hesitate in stating that the specimens made and deposited by Howell & Brothers, of Philadelphia, are considered by them much superior in taste, style, colors, and manufacture, to any ever before exhibited. They particularly notice the specimen of elaborately flowered fresco-paper, as being, for colors and workmanship, unequalled by any thing of the kind ever made in this country. To the manufacturers above mentioned, we cheerfully award a First Premium.

XVII.—*Fine Arts.*

Among the paintings in oil and water colors are several pieces of great merit; but this branch of the fine arts being more dependent upon creative imagination and fine taste, than upon mechanical execution, it seems not to be so closely allied to the leading objects of the Institute, as some other branches of what is usually denominated the

fine arts. These paintings, however, add to the attractions of our exhibitions, and we are willing to award to them all due credit, though on the present occasion no premium is recommended for paintings.

No. 1224, picture of a sleeping child, and two portraits, by G. W. Conarroe. These are beautiful paintings,—life-like and sweetly natural;—worthy of the well established reputation of this well known and skilful artist.

No. 1270, fruit pieces and landscapes in oil and water colors, by A. B. Engstrom. These paintings are well executed and very creditable to the artist :—the fruit is particularly good, and has a most tempting appearance.

No. 1269, landscapes and fruit, by Margaret Parker, a pupil of Engstrom, are well executed and possess considerable merit.

No. 1219, view on the Mediterranean, by Bonfield, is a good painting and deserves notice.

No. 1238, crayon drawings, by Ph. Beaugureau. The execution of these drawings is admirable, showing great skill and exquisite delicacy of touch. They are awarded a Third Premium.

No. 1239, crayon drawings by Ph. Beaugureau jr.,—a lad of 15, son of the last mentioned artist,—are very well done, and give promise of future excellence in this young pupil.

A considerable number of drawings, executed by pupils in the High School, are exhibited, many of which are highly creditable to those by whom they were drawn, and give good evidence of the attention which this useful branch of education receives in that institution.

No. 1226, a map of Germany, from an electrotype plate, by S. Siebert: a perfect copy of the original, which is deposited with it.

No. 1201, engravings, by W. H. Ellis: well executed and creditable to the engraver by whom they were produced.

No. 1257, specimens of medallion ruling, by Asa Spencer. Good specimens of this art.

No. 1268, two plaster busts, by J. Battin, are very good and creditable to the maker.

No. 1217, two specimens of porcelain painting, by M. Strasser, Philadelphia. These paintings are beautifully executed, and the colors well and harmoniously blended,—though the general effect of the work is somewhat impaired by defects in the drawing. The judges recommend the award of a Third Premium.

The display of daguerreotypes is unusually fine; and the establishments of Langenheim, Collins, Simons, Plumbe, Root, Shew, and McClees & Germon, have contributed a great variety of excellent specimens in this branch of art. Of these depositors, Langenheim, and Simons & Collins received a first premium last year; and we consider some of the specimens now deposited by Plumbe, Root, Shew, and McClees & Germon, as being fully equal in merit to those which obtained this premium at the last exhibition ;—but we deem the several collections now deposited so nearly of equal merit that we are unwilling to express a preference by making an award in favor of any depositor.

XVIII.—*Silver Ware and Jewelry.*

The quantity of goods in this department is smaller than has been witnessed at some former exhibitions, and although several of the pieces of plate are very well made, and considerable improvement is noticed in the chasing of several, the judges do not consider the general character of the work superior to that exhibited last year.

No. 642, a lot of silver ware, by W. Wilson, Philadelphia, fully sustains the reputation of the maker, who received a First Premium at the last exhibition.

No. 673, silver ware, by Conrad Bard, Philadelphia. This case contains some plain work equal to any exhibited. The fireman's horn, the plain teapot, and the large bowl are noticed as good samples of hammering, and entitled to a Third Premium.

No. 675, a gold pencil case, by Hopper, Boss & Co., Philadelphia, is considered as a first rate piece of workmanship, with a very ingenious contrivance for introducing leads into the point from the chamber, without any separation of the parts. The judges consider this as a decided improvement on the old plan, and the committee recommend to the maker an application to the Committee on Science and the Arts for an examination of the article.

No. 695, a case of jewelry, by Osborn Conrad, Philadelphia. This work is set with stones cut from Cape May pebbles; the workmanship is very good and highly creditable to the maker.

XIX.—*Marble and Statuary.*

None entered in time for competition.

XX.—*Hats and Caps.*

No. 955, silk hats, by John Hile, Philadelphia. Very superior articles, and deemed worthy of a Third Premium.

No. 987, hats and caps, by Hunt and Getz, Philadelphia. These hats are neatly got up; but in some points of finish are somewhat deficient. A drab beaver hat in this case is thought to be deserving of a Third Premium.

No. 992, hats and caps, by B. Stratton, Philadelphia. A very excellent lot of articles, which merit a Third Premium.

No. 1021, hats, by John Kuhn, Philadelphia. Excellent, and creditable to the maker. Some doubt exists whether these hats were entered in time;—if they were, they are entitled to a Third Premium.

No. 1022, hats, by Sullender and Pascal, Philadelphia. These are regarded as the best exhibited. The material is good; they are well made, and beautifully finished and trimmed. The silk hat, particularly, is faultless. We award a First Premium.

The judges also make favorable mention of articles in this line deposited by John L. Young, E. S. Williams, Samuel Hudson, B. Lightfoot, Francis Bacon, Charles Oakford, E. Kimber, Jr., and others.

Considerable difficulty and confusion has occurred in this department from the practice of depositors entering their *cases* on our books

in time; while in some instances the *hats* were not deposited until after the opening of the exhibition. The remedy for this will be a rigid adherence to the rule of making no entry on the books, until the goods themselves are actually placed in the rooms.

XXI.—*Combs and Brushes.*

The articles exhibited in this department were generally of excellent character, and the judges report the following as the result of their examinations.

No. 934, combs, by S. Winner, Philadelphia. A beautiful display, of great variety, showing much skill and taste in the execution. A First Premium.

No. 966, brushes, by Abel and Bicknell, Philadelphia. This case comprises an extensive variety of fancy and plain patterns, evincing a high degree of taste and skill. We award to the makers a First Premium.

No. 984, combs, by Charles Flagg: this collection is small, but of excellent workmanship.

No. 920, paint brushes, by E. L. Mintzer, are beautiful and evince a high degree of perfection.

No. 911, brushes, from the Pennsylvania Institution for the Blind. These are considered by the judges as beautiful specimens, and entitled to favorable notice.

XXII.—*Coach Work.*

No. 1556, vehicles by W. Dunlap, Philadelphia. These articles the judges consider as unsurpassed for superior workmanship, elegance of taste, and just proportions. They are fully equal to the work for which the maker received a First Premium last year.

No. 638, elliptic springs, deposited by H. & G. Fricke, Philadelphia. Of superior finish and excellent workmanship. To the maker of these springs, whenever his name shall be disclosed to the committee, they award a First Premium.

No. 1587, Resolution hose carriage, by George Ruhl, Philadelphia. Of excellent workmanship and taste. To the maker is awarded a First Premium.

No. 1540, Pennsylvania hose carriage, and 1588, Kensington hose carriage, by Boyle and Jeffries, Philadelphia. Excellently constructed, in good taste, of strong and creditable workmanship and materials. The makers are entitled to a First Premium.

No. 1593, Reliance fire engine, by Joel Bates, Philadelphia. Strong, substantial, and well built for action. The maker deserves a First Premium.

No. 635, coach bolts, by E. & P. Coleman, Philadelphia. A fine and superior article, worthy of a Third Premium.

No. 698, coach bolts, by John Jones, are good, and creditable to the maker.

XXIII—*Leather and Morocco.*

No. 352, sole leather, by Francis Shriver, Westminster, Maryland.

This leather is said to have been tanned in four months, by Brown's patent process. It is solid and well tanned, and the judges regard it as the greatest improvement in the article of leather ever submitted to the public. It is considered worthy of a First Premium.

No. 312, sole leather, by C. B. Williams, Philadelphia. This is an excellent article, well tanned, and prepared with care. The judges consider it worthy of particular notice, though not better than that for which the maker received a premium last year.

No. 305, sole leather, by W. H. Crawford, is a very good article. Mr. Crawford also received a premium at the last exhibition.

No. 372, calf skins, by H. M. Crawford. One dozen of these skins deserve particular notice. The material, tanning, and currier's work are better than any French calf skins the judges have seen, though not much better than those previously exhibited by the same maker. They are solid, soft, and smooth, and do not rumple with handling as others. The committee award a First Premium.

Other specimens of sole leather and calf skins are creditable but of no particular excellence.

The patent and enamelled leather is considered as highly creditable; but no award is recommended by the judges. The specimens of morocco are very good; but not particularly remarkable for any extra qualities.

XXIV.—*Boots and Shoes.*

This department of the exhibition is creditable to the depositors, for quantity, quality, and variety, particularly in the branch of ladies' work.

No. 308, ladies' gaiter boots and shoes, by Wm. Ryan & Co., are considered by the judges as superior to any exhibited, for style, workmanship, durability, and neatness of finish. They merit the award of a First Premium.

No. 357, ladies' gaiter boots and shoes, by C. Fontaine. Fine specimens of the French style of work, and entitled to a Second Premium.

No. 379, ladies' winter shoes, by J. R. Douglas. These are worthy of notice as creditable specimens of his efforts to make them water proof.

No. 387, gentlemen's dress boots, by L. Benkert. This work is creditable to him as a mechanic: he received a first premium at a former exhibition for the same kind of work.

No. 335, gentlemen's dress boots, shoes, and slippers, by C. Corvaizier. Worthy of notice for workmanship, durability and taste.

No. 375, gentlemen's boots, shoes, and slippers, by H. Herth. The ornamental and fancy work on the tops of one pair is equal to any French boots imported. They are all worthy of notice for neatness.

No. 331, gentlemen's dress boots, by C. Benkert. Very creditable to the maker; but not better than those for which he formerly received a premium.

No. 338, shoemaker's tools, by C. H. Blittersdorff. For exquisite finish and adaptation to the intended uses, these articles deserve a First Premium.

XXV.—*Chemicals.*

In this, as in some other departments of the exhibition, owing to the delay of depositors in bringing in their specimens, the list of articles entered in time for the judges' list was unusually small, though the tables were afterwards profusely covered with articles of great beauty and merit.

Nos. 311, 313 & 323, starch, from the manufactories of Altemus, Colegate, and Kester & Walmsley. All the specimens are of handsome appearance, particularly that by Altemus; but it is not free from acid, which impairs its quality. An acid taste, though in a slighter degree, was manifest in the other specimens, though that of Kester and Walmsley presented it but faintly.

No. 336, chemicals, by Thos. S. Wiegand, of the U. S. naval hospital, N. Y. These are samples of the articles furnished to the U. S. vessels sailing from that port, and exhibit very praiseworthy care in the preparation. They deserve a Third Premium.

No. 353, iodide of lead, by S. M. Bines;—a very beautiful preparation.

No. 332, tannic acid, by H. A. Guier; a handsome specimen entitling the maker to great credit.

No. 371, prussiate of potash, by Smith and Worthington;—a very beautifully crystalized specimen of this important article,—worthy of a Second Premium.

No. 378, pine oil, by B. T. Davis, Camden, N. J.—This bottle is stated by the maker to be the material ordinarily manufactured by him for use in lamps, which are now extensively used. As the article is of very considerable economical interest, and is extremely pure and carefully prepared, the judges recommend the award of a First Premium.

No. 351, black lead crucibles, from the Phœnix Manufacturing Co., Taunton, Mass., deposited by Cresson, Fisher & Co. One of them was submitted to trial by the melter and refiner in the U. S. mint, who reports it equal if not superior to the best German pots, having stood not only a high heat, but the action of the most corrosive fluxes, without apparent injury. The committee therefore award to the makers a First Premium.

No. —, acetate of lead, by Mordecai Lewis & Co. A beautiful specimen of crystalization, for which the judges recommend a Second Premium.

The committee regret that the articles deposited by Farr, Powers & Weightman, Wetherill & Brothers, and the black lead crucibles by Mr. Dyre, came too late to find a place on the list furnished to the judges.

XXVI.—*Philosophical Apparatus.*

The number of articles deposited under this head, in time for com-

petition, is not so great as in some former years; but many of them show a decided advance in workmanship and appearance.

Nos. 614 & 696, mechanical powers, and air pump, by L. C. Francis. Well made and creditable articles, to which we award a
Second Premium.

Nos. 626, 618, 634 & 651, electro magnetic coils, by Bingham, Gumpert, Neff, and Stratton. All these instruments appear to answer their purpose equally well, and any preference by the judges relates only to the simplicity or compactness of the contact-breaker, &c. No. 626, by Bingham, has the contact-breaking magnet included in the main coil. We award to it a Third Premium. No. 618, by Gumpert, for the compact form of the secondary magnet and contact-breaker, is also worthy of a Third Premium.

No. 648, an improved compass and level, by Wm. J. Young: made with the accuracy and skill which always characterize Mr. Young's instruments: a Second Premium.

No. 714, set of standard weights and measures, scale beams, &c., by F. Meyer & Co. The judges notice, with pleasure, the continued improvement in neatness and workmanship shown by Messrs. Meyer & Co. at each successive display, and regard the present set of standards, if any thing, rather superior to those for which a first premium was awarded last year. For the accuracy of adjustment of a large druggists' balance, we now award them a Second Premium.

No. 720, a large balance for weighing gold,—made at the U. S. Mint, under the direction of Franklin Peale, Esq. This instrument has excited high and deserved admiration. The intrinsic perfection of its design and workmanship will add, if possible, to the reputation which the workshops of the Mint have already long possessed. The case is so contrived as to give perfect protection to all the working parts of the balance, while free access is at the same time allowed to the pans. To its constructor, Franklin Peale, Esq., is awarded a
First Premium.

No. 625, a set of slides for magic lanterns, by Henry S. Nolen;—very well executed, and worthy of a Third Premium.

No. 628, galvanic bands, by Bucklin & Mills. The amount of electrical action, which these bands can produce, must be so trifling as, in the opinion of the judges, to render them inefficient for medical purposes.

Among the articles entered too late for competition, we notice a well made magneto-electrical machine by Francis; and a well designed and constructed apparatus, by Duffey, for illustrating the refraction of light.

XXVII.—*Straw Goods.*

This department is one that gives employment to a large number of persons, and the work is of a kind peculiarly adapted to the employment of females: hence, if proper attention and encouragement is given to it, it may be found of great value to the community.

No. 932, a bonnet, by Eliza Garrigues, knit of American cotton thread,—is a very good and durable article, neatly made, and formed

in proper style. For the skill shown by this lady, and the beauty of the article, we award a Second Premium.

No. 944, straw bonnets. China pearl, Coburg, and gimp, by Mrs. Buckman, of Lambertsville, New Jersey. Great perseverance and skill are shown in the manufacture of these articles, and they are a very fair imitation of imported goods of the same kind. They are worthy of a Second Premium.

No. 976, a rye straw bonnet, by Jane M. Atwood, of Salem, Washington county, New York. A very durable article, being well sewed and plaited,—and evinces much ingenuity and skill. We consider her deserving of a Second Premium.

No. 933, open straw and hair gimp trimmings, by D. B. Legg. These are of neat and beautiful workmanship,—and merit a Third Premium.

No. 936, straw bonnets, hats, and caps, by Mrs. Wythes. For their neatness, beauty of style, and good workmanship, we award a Third Premium.

XXVIII.—*Surgical Instruments.*

Among this class of articles the judges remark a number of cases of artificial teeth which in some respects are equal to those heretofore exhibited, and in others surpassing them.

No. 615, artificial teeth, by Dr. G. Plantou. These are deemed the best in the exhibition, because they most accurately imitate nature. The judges recommend to the maker a First Premium.

No. 652, dentist's plate-work of gold, by Dr. R. T. Reynolds. The judges consider this the best we have ever had in our exhibitions, and recommend a Second Premium.

No. 664, artificial teeth, by Wilkinson and Armstrong, are better than common, and merit a Third Premium.

No. 665, dental articulator, by Thomas Wardle, deserves a Third Premium.

No. 663, an artificial leg, by B. Franklin Palmer, of Meredith, Maine. This is considered by the judges as deserving of much commendation, being the best they have ever seen. This article has been referred to the Committee on Science and Arts for a further examination.

Among the articles entered too late is a dentist's chair, of a new and very simple construction, made by John Barr, and deposited by Dr. W. S. McIlhenny.

XXIX.—*Perfumery.*

But few articles in this line were deposited which merit any especial notice. The only award made is the following:

No. 389, a lot of fancy soaps, by Thomas Worsley, Philadelphia, which the committee think deserve a Third Premium.

Mr. Hinton also exhibits Cologne water of excellent quality, equal to that for which he received a Premium last year.

Shaving cream, by L. G. Bull, also appears to be good and is neatly put up.

XXX.—*Gum Elastic Goods.*

The judges on this branch report, that the goods deposited in time to be examined by them are less in quantity and variety, than at former exhibitions. They think that the articles deposited by Thornley, and also those by Ripley, are equal, but not superior, to specimens formerly exhibited by the same manufacturers.

XXXI.—*Copper, Brass, and Plumbers' Work.*

No. 601, an ornamental revolving fountain, by John Dutton, Delaware county, Pennsylvania. A very neat piece of workmanship; but the judges, not having seen it in operation, decline expressing an opinion with regard to its merits.

No. 1629, brass cocks, by Henry English, Philadelphia. The workmanship is very creditable, and the articles are well finished.

No. 1653, leather hose, by G. & W. Dialogue. The materials and workmanship are of the very best quality. The makers are of well known reputation, and have received favorable notice at former exhibitions. We now award them a Second Premium.

No. 1529, hemp hose, by Amasa Stone. A valuable article for purposes where warm liquids are used; for ordinary use by firemen, it is not so durable as leather.

XXXII.—*Tin Work.*

No. 1639, a lot of tin work, by Isaac S. Williams, Philadelphia. Of this work the judges speak in terms of high commendation; especially of the planished work, for which they recommend a first premium; but Mr. Williams being a member of the Board of Managers, our rules forbid any award to him.

No. 1658, revolving cans, for factory use, by H. W. Butterworth, Philadelphia. This is good and durable work, of the same kind for which the maker received a premium last year.

XXXIII.—*Paints and Colors.*

No. 361, Prussian blue, by Robert B. Potts, Philadelphia. This article is of excellent quality, and is regarded by the judges as superior to any in the market. They recommend for it the award of a First Premium.

Several specimens of white lead were exhibited, which the judges deem equal to any imported both in body and in color. On account of the very slight difference existing between these white leads, and other specimens in this and former exhibitions, the judges state that they feel a delicacy in making any award, fearing they may do injustice to some of the parties.

A number of very good articles in this department were brought in too late to come under the notice of the judges.

XXXIV.—*Fancy Articles.*

The amount of indifferent and uninteresting articles deposited under this head, is this year considerably less than usual; but we still find on the list many which it would have been as well for their de-

positors to have left at home. The following is extracted from the report of the judges.

No. 902, a case of fancy articles, by Mrs. Waterman, are tastefully executed, and merit the award of a Third Premium.

No. 905, fly brushes and fans, of peacock feathers, by Jacob Wilt. Handsome and ornamental; well made, in good taste. A Third Premium.

No. 922, fancy feathers and military plumes, by Mrs. Griffiths, late Freeman. These goods are equal in excellence to those for which the maker received a premium at the last exhibition.

No. 967, pearl work, by R. & A. Walter: Beautiful, and deserving of a Second Premium.

No. 927, military equipments, by Wm. Pinchin: Admirable specimens of workmanship in this line: the designs excellent, and the execution tasteful. They merit a Second Premium.

No. 971, face caps and flowers, by Miss J. Juel: Elegant and tasteful ornaments for ladies' head dress; deserving a Third Premium.

No. 904, glass hair dresses, by Joseph Weed, Kensington: Neatly made, in the ordinary style of glass weaving.

No. 968, morocco satchels, by Miss A. Williamson: A neatly made and serviceable article.

No. 924, fancy confectionery, by J. F. Sheek: Good things, handsomely ornamented, and very creditable specimens in this branch of art.

No. 1024, pickles, by T. B. Smith: Prepared in his usual excellent style, and similar to those for which he received a premium at a former exhibition.

No.—, fancy worsted work, by Mrs. Robinson: Admirably executed, and worthy of a premium had it been sent in time.

No. 1033, bead work, by L. E. Massey: too late; but worthy of notice for neat and excellent workmanship.

A number of other very good articles were brought too late to receive the requisite attention and notice.

XXXV.—*House-Keeping Articles.*

The articles in this department exceed in variety and number those at any former exhibition. They are in general well made, and properly adapted to the purposes intended. In our examination of them we have been kindly aided by a committee of ladies, whose report gives evidence of minute and careful attention, as well as sound and discreet judgment.

No. 1506, washing machine, by Ira Avery: recommended to a favorable notice on account of its compactness and portability. It is accompanied by a wringing machine, which appears to act very efficiently.

No. 1509, a shower bath, wash stand, and dressing table combined; made by L. Stebbins. This is an elegant, neat, and compact article, which we consider worthy of a Second Premium.

No. 1516, washing machine, by E. Lukens: highly recommended by those who have used it.

No. 1259, housekeeping articles, by Wm. Boyer; consisting of sieves, cucumber cutter, cabbage cutter, almond cutter, &c., &c., very neatly made and useful articles. The almond cutter is worthy of special notice.

No. 1533, cedar ware, by S. Tompkins: good and creditable work.

No. 1264, brooms, by Manly Rowe: well made articles.

No. 1557, basket work, by Robert Swift, deserves favorable notice. A small basket, made by John Lafferty, aged 12 years, of very neat workmanship, deserves a Third Premium.

No. 1573, churns, by E. Spain. A great improvement is observable in the dashers of these churns, by which the cream is agitated thoroughly in the centre, as well as at the circumference, thus expediting the process; and being so contrived as to be removed from the body of the churn, when necessary for cleaning. To the maker is awarded a Second Premium.

No. 1597, sliding top shower baths, by John R. Wheeler. Handsomely finished and useful articles.

No. 1598, a refrigerator, by James Smith. This article is lined with zinc, filled in with pulverised charcoal, and has movable shelves. For its neatness, compactness, and utility, it is worthy of favorable notice.

No. 1599, a cellar screen, by Owen Baldwin, is very neatly made.

No. 1600, washing machines, by Beck & Porter. These machines have an ironing table attached, which is a useful appendage.

No. 1615, refrigerators and filter, by Oliver Evans. Made in his usual good style, and very similar to those by him at former exhibitions.

No. 1648, bread knife, by E. W. Bushnell. This instrument performs its work admirably; cutting the bread, if required, into very thin slices, with great ease. We consider it worthy of a Third Premium.

Velocipedes, by the same maker, for little girls, are beautifully finished, and deserve favorable notice.

Several barrels of very good flour were exhibited, which was carefully examined, and bread made from the flour in each barrel was baked in the cooking stoves in the exhibition. The judges were unanimous in opinion that the flour from No. 1508, by David Leech, Leechburg, Penna., deposited by A. Wright & Nephew, is greatly superior to any other exhibited, both as regards whiteness and quality. We award to it a First Premium.

XXXVI. *Clothing and Needlework.*

Having last year been efficiently aided by ladies of taste and judgment in the examination of articles in this department, we have on the present occasion again solicited female assistance, which has been cheerfully and diligently rendered. From their neat and lucid report, we make the following awards and notices.

No. 911, a great variety of articles made by the pupils of the Pennsylvania Institution for the instruction of the blind. Many of these

specimens possess much merit, and would be creditable to seeing persons. The knitted polka, by Sarah Marsh, is equal in beauty and finish to any exhibited. For the whole display, and to encourage the pupils of that valuable institution, we award a

Second Premium.

No. 981, children's clothing, by Mrs. Edwards: Exceedingly beautiful in design, and of superior workmanship. Worthy of a

Second Premium.

No .938, Odd Fellows' Regalia, by J. W. & E. D. Stokes; and No. 997, the same, by L. Hyneman. All rich and elegant in design and execution. Those by Stokes are considered superior, and deserving of a

Second Premium.

No. 958, a fire screen, by Mrs. R. Rittenhouse, Germantown. A very beautiful specimen of needlework; perfect in design; colors well blended, and of admirable execution. It merits a

Second Premium.

Nos. 925, 926, specimens of embroidery, by Miss Gillespie. Beautiful examples of tufted needlework, for the general merit of which we award a

Second Premium.

No. 928, embroidery, by Eliza W. Pidgeon. A very elaborate piece of needlework, of excellent workmanship, though the colors on some parts are not properly blended. The needlework deserves a

Third Premium.

No. 1009, French plaiting, by Madame Juery: very beautifully executed. One of the judges witnessed the process, and testifies to its being entirely done with the fingers and with great rapidity. It merits a

Third premium.

No. 962, embroideries and caps, by S. A. Harrison. Creditable articles, taken from the stock on hand.

No. 1012, embroideries, &c., by Madame Fillot. Superior in workmanship and tasteful arrangement.

No. 921 & 945, woven coverlets, by Mrs. Myers and Mrs. Fretz. Of more tasteful pattern than those formerly exhibited.

No. 916, knitted bed spread, by Mary Alsop. This is a creditable article; but not equal to one of similar appearance, but without seam, by Miss Smith, which came too late for competition.

Concerning the bed quilts, the judges remark that they perceive no improvement in design or workmanship, over those exhibited last year.

Nos. 952, 977, 1000, shirts, stocks, and wrappers, from the establishments of Messrs. Walborn, Ward, and Lancaster. A number of these are of good workmanship and pattern; but none so far superior to those exhibited last year, as to be worthy of particular remark.

Several well made coats and other articles of gentlemen's clothing were brought too late for entry on the lists furnished to the judges.

It is a subject of regret that the display of plain needlework is not greater. Articles of ordinary wear as well deserve consideration as those intended for ornament; and it is hoped that, upon another occation, more attention will be paid to that branch of domestic industry.

Obituary notice of the late Isaiah Lukens. *(Read before the Franklin Institute, at its Monthly Meeting, November* 19, 1846.*)*

Isaiah Lukens, late Vice President of the Franklin Institute, departed this life on the twelfth of November, 1846, at his residence in Market street, Philadelphia. His death was occasioned by the rupture of an aneurism of the aorta, a disease to which he had been subject for several years, and of the probably fatal termination of which he appears to have been for some time fully sensible.

He was descended from one of the most ancient families of settlers in Pennsylvania; his ancestors having come to this country from Holland or Lower Germany in 1698, about the time of the second and last visit of William Penn to his colony. His progenitor, Abraham Lukens, settled as a farmer at or near Germantown, about the time of the first laying out of that village.

The Lukens family afterwards extended by its various branches into Montgomery county, where they were generally remarkable for their skill and ingenuity. John Lukens, who was for some time Surveyor General of Pennsylvania, was a member of this family, and was noted for his ability as a surveyor and mathematician.

Seneca Lukens, the father of our deceased friend, resided on his farm at Horsham, in Montgomery county, where he also carried on the business of a clock and watch maker; and his son having a strong taste for mechanical pursuits, soon became skilled in this business under the instruction of his father.

Isaiah Lukens was born in August, 1779, and having received such education as was then afforded by country schools, he established himself, on coming of age, in the business of his father as a clock and watchmaker. But his country situation did not afford a sufficient opportunity for the full development of his mechanical genius and his extended views; and about the year 1811 he removed to Philadelphia, where his peculiar genius and fondness for scientific investigation soon brought him into connexion with those of similar pursuits, at a period when such subjects were attracting much attention, and science was rapidly advancing, both from discoveries in Europe and the increasing taste manifested for it in this country. He soon took an active part in the promotion of useful knowledge, not only as a practical mechanician, but with a fair understanding of the principles both of mechanics and natural philosophy, which form the basis of the mechanic arts.

In the year 1813, a belief in the delusive principle of *perpetual motion* was created throughout a considerable portion of the community by a deceptive machine constructed by Redhoeffer, and had gained sufficient character to induce an inquiry into its reality by the appointment of a committee from the Legislature of Pennsylvania. The attention of Mr. Lukens was turned to this subject, and although the actual moving cause was not discovered, yet the deception was so ingeniously imitated in a machine of similar appearance made by him, and moved by a spring so well concealed, that the deceiver was him-

self deceived, and Redhoeffer was induced to believe that Mr. Lukens had been successful in obtaining a moving power in some way in which he himself had failed, when he had produced a machine so plausible in appearance as to deceive the public.

After having successfully conducted his business in Philadelphia for several years, his attention was called to the new invention of Professor Civiale, of Paris, for the operation of Lithontripty, to which instrument Mr. Lukens undertook to add several important improvements. A desire to introduce these with the use of the instrument, induced him to visit Europe; but there his improvements, though of acknowledged merit, do not appear to have obtained due consideration or the requisite fair experiment, partly, perhaps, on account of the jealousy naturally felt at the interference of a foreigner not gifted with a medical title. To this cause did he attribute his being prevented from obtaining the just reward of his skill and ingenuity in the improvement of this instrument.

Disappointed in the object of his voyage to Europe, and in the expected emolument to be obtained for his improvements, he resorted for support to his business as a clock and watch maker. Availing himself of his superior knowledge in making springs for chronometers, and his ability to make surgical instruments of an improved kind by a better method of tempering steel, he in this way obtained funds for his maintenance during a stay of three years in England and France.

After his return to Philadelphia, in 1828, he was employed in making clocks for public buildings and institutions in this city and distant places. Among his works of this kind may be mentioned the clock in the State House at Philadelphia, those made for the Bank of the United States, the Philadelphia Bank, and others, which remain as monuments of his skill in introducing improvements, as well as of the accuracy and fidelity of his workmanship,—and which may challenge competition with similar articles in any part of Europe.

The requisite observations for keeping the city time in Philadelphia were committed to him, and these were obtained from his own transit instruments. Such observations are important, not only for the mere adjustment of the public clocks; but as a means of obtaining the true time for the regulation of marine chronometers, so indispensable for the purposes of navigation, and affording the readiest means of computing the longitude at sea.

The acquirements of Mr. Lukens were not confined merely to mechanical science; nor was his attention exclusively directed to subjects connected only with that particular branch of knowledge. He possessed a taste for the study of mineralogy and other departments of natural science, in which his attainments were creditable to himself and useful to others. He felt a lively interest in the progress of useful improvements, and from his general knowledge and habits of close investigation, was well qualified to judge of their merits,—encouraging such as were deserving, by his approval and influence.

On the establishment of the Franklin Institute for the promotion of the mechanic arts, he was one of its earliest members and supporters; and was chosen as Vice President, at the first election held by the

society, on the sixteenth of February, 1824. As a member and officer of the Institute, from that time until the period of his death, he was eminently useful; freely yielding his time and attention to the various duties which he was required to perform,—and by his advice and assistance aiding and supporting the Institute in its various operations for the benefit of science and the useful arts. His punctuality, diligence, and intelligent service on committees appointed for the investigation of many important subjects, will be long remembered among us; while the kindness of his disposition, and the many amiable and excellent qualities of his heart and his mind, endeared him, in an eminent degree, to those who enjoyed opportunities of familiar intercourse with him.

The Franklin Institute considers this notice and memorial of its deceased Vice President as justly due on the present occasion; not only from his position as one of its chief officers,—but also on account of his general services to the society on all such occasions as called for the exercise of his knowledge and abilities in its behalf,—as well as for the readiness of his disposition to promote objects of utility and the interests and purposes of the Institute.

Mr. Lukens was also a member of the American Philosophical Society, and of the Academy of Natural Science,—and these societies, in common with our own, have suffered by his death a loss which will be deeply felt and sincerely lamented.

MECHANICS, PHYSICS, AND CHEMISTRY.

The Gun-Cotton.

We insert the following notices of the new discovery of Explosive Cotton, which is now attracting much attention. Several chemists in Philadelphia have succeeded fully in manufacturing the article; and, at the meeting of the Franklin Institute, held November 19th, 1846, Dr. James B. Rogers, Professor of Chemistry in the Institute, exhibited a number of specimens manufactured by him, which were highly explosive and adapted for use in fire-arms. Dr. Paul B. Goddard exhibited drawings of filaments of cotton as seen by means of a microscope of high magnifying power, and explained how the gun-cotton may be readily distinguished from common cotton by this means.

COM. PUB.

From the Washington Union.

Extract from a letter received in this city, dated

"BREMEN, Oct. 12, 1846.

"The secret has been discovered by a celebrated chemist, Professor Otto, of Brunswick, and by him promulgated to the world. I hasten to furnish you with translations of two publications which he has just made concerning it.

"The gun-cotton can be prepared, under the accompanying directions, by any apothecary who understands his avocation properly. Many experiments have been made with it in this city, and the result uniformly has been such as to establish general confidence in its vast superiority over gunpowder—an estimation which, from the first, I believed it would attain."

[Translation.]

From the Hanover Gazette.

BRUNSWICK, Oct. 5, 1846.

Totally independent of Schönbein and Böttger, relying on an observation of Pelouze, which is contained in my compendium of chemistry, first volume, page 136, I have succeeded in preparing *exploding* cotton, which, after experiments made with it, seems to be an excellent substitute for gunpowder. In order that the results of important discoveries may be brought to the highest degree of perfection, without unnecessary delay, it appears to me to be proper to give publicity to them immediately, in order that other scientific persons may occupy themselves in making improvements upon such inventions. I therefore disdain to sell or ask a patent for the highly valuable one which has been made by myself, the vast consequences of which cannot yet be calculated, and I herewith give publicity to it for the general use of the public.

For making exploding cotton the common well-cleaned staple must be dipped in highly concentrated *acid* of saltpetre, (the *acid* which I use is made by distilling ten parts dried saltpetre, and six parts oil of vitriol or sulphuric acid,) then it is put into fresh water, which is often changed, and care must be taken to loosen thoroughly the cotton, which, from the process, becomes matted; after which, it must be well dried. Thus the exploding article is in a state of preparation for the gun-barrel.

The effects of this article astonish every body who witnesses them. The smallest quantity explodes with the quickness of fulminating quicksilver powder, if struck with a hammer on an anvil. If put into a gun, a smaller quantity in weight will do as much execution as gunpowder. It is used precisely in the same manner as gunpowder—a piece of paper being necessary between the ball or shot, as in ordinary firing. The ignition is always certain from the explosion of a percussion cap. All persons, without exception, who have been present at the exhibitions I have made of its properties, were fully convinced of its practicability. The testimony which I annex of two distinguished persons, who have made arms their profession, will corroborate my statements:

"Yesterday, the 4th of October, we were present at the first experiments which were made with the exploding cotton, in the laboratory in this city, and to-day we have convinced ourselves of the perfectly satisfactory results, with sharp loaded fire-arms.

HARTEG,
Doctor, counsellor of Forest Board.

A. VON SCHWARZKOPPEN,
High Forester."

Extracts from the second report of Professor Otto, assessor of the medical board, chemist, &c, &c., &c.

" It seems that no other acid than that produced by the distillation of ten parts of saltpetre, and six parts of oil of vitriol, will confer upon raw cotton its explosive power. Hydrate of nitric acid *(salpetersäürehydrat)* dissolves the cotton. In good proper acid, the cotton becomes transparent, and the fibre is not injured or dissolved. The aid by distillation first produced is best. Cotton dipped into it for half a minute, and then quickly pressed between glass plates, or boards, and washed afterwards until it is entirely free from acid, and subsequently dried, produces a superior exploding article. Using the acid a second time, an inferior article is made; but if after having been washed and dried it is again dipped into the acid it becomes excellent. A repetition of the manipulation necessarily augments the exploding quality. Cotton may even remain in the acid longer than half a minute. That which has laid in it as long as twelve hours was found to be very explosive. It is important that the cotton be well washed when it is taken out of the acid; for if any remains in it, a saltpetre flavor will attach to it when dry, and when exploding will leave on anything white an acid tincture. The vivid explosion of a small ball of the article, on a white china plate, is the criterion to test its good quality by. It must flash like gunpowder, and leave no dust behind it. If a particle even is seen it cannot be used in guns. It also appears to be necessary that the cotton, after having been dipped into the acid and pressed, be immediately put into a large quantity of water. If the cotton be put into an insufficient quantity of water, it (the cotton) gets heated; and small quantities of cotton are also preferable; for, if large, it forms into knots of a bluish-green color, which are so firm, as not to be easily loosened. The more the *prepared* article resembles the one in its *natural* state, the better and more powerful it is. With $\frac{5}{4}$ths or $\frac{6}{4}$ths of a *gran*—480 *grans* equal to an English ounce—balls of $\frac{1}{2}$ inch diameter were driven through boards one inch thick. With 6 *grans*, a bullet was driven from a rifle, at a distance of 45 steps, into an oak plank, to the depth of an inch; and, with four or five grans, effectual shots have been made with fowling-pieces. The more readily the cotton explodes, the greater the care to be taken in handling it."

Professor Schönbein, at an experiment made in presence of one of the editors of the Times, tested some gun-cotton which had been immersed in water *sixty days*, and found it as good as when perfectly fresh, after having been dried.

To the Editor of the Union:

ORDNANCE OFFICE.

Washington, Nov. 13, 1846.

Enclosed is a copy of Capt. Mordecai's official report of the comparative forces of "gun-cotton" and gunpowder, so far as the small

quantity of the former would admit of a trial.

I am, dear sir, yours, &c.,

G. Talcott,

Lieut. Col. Ordnance.

Washington Arsenal,

Nov. 13, 1846.

Sir:—The following tabular statement shows the results of the comparative trials made yesterday, at this arsenal, with rifle powder, and a sample of the *gun-cotton* prepared by Professor Schönbein and brought to this country by Mr Robertson.

Experiments with the musket pendulum.

Kind of powder.	Charge.	Height of charge in the musket.	Initial velocity of the ball.	Remarks.
	Grs.	Inches.	Feet.	
Duponts rifle powder	120	1.8	1,531	Mean of three rounds.
	60	1.25	1,062	Ditto.
Gun cotton.	30	1.6	971	Charge rammed slightly, after the ball was inserted; some of the cotton was expelled unburnt.
	60	1.8	1,426	
	60	2.5	1.567	
	50	2.6	1,489	

The quantity of cotton offered for trial was too small to admit of a repetition of the experiments. The above results are, therefore, to be regarded as only approximative. To give a fair indication of the force of this new explosive substance, it would be necessary to make experiments as to the best mode of using it in the gun, especially with regard to the proper degree of compression by ramming. A comparison of the results of the two charges of 60 grains shows, as might be anticipated, a marked variation produced by different degrees of compression. The ball and wad occupying, in every case, a height of about ¾ inch, the space occupied by the cotton or the gunpowder may be deduced from the height of the charge given in the table.

From these trials the gun-cotton seems to produce, in the musket, an effect equal to about twice its weight of good rifle powder. This cotton leaves a small quantity of a dark-colored residuum in the musket barrel, extending from the breech to about half the length of the barrel; this residuum is easily removed by wiping the barrel with a rag. The combustion of the gun-cotton is unattended with smoke; the report made by it appeared to me sharper than that produced by gunpowder.

It may be proper to add that Mr. Robertson does not consider this sample of the gun-cotton to be of the best quality.

Respectfully, your obedient servant,

A. Mordecai,

Captain of Ordnance.

Lieut. Col. Geo. Talcott,

Ordnance Department.

Painting on Glass.

A paragraph now and then makes the round of the newspapers to the effect that such a one, in Belgium or elsewhere, has discovered some ancient receipt, containing the whole secret of "the long lost art" of Painting on Glass. Now the fact is, that this secret has been in print (and, I believe, easibly accessible) for years :—the only singularity is that, though the receipts are given at full length, artists have failed to recognize what was under their very eyes. These seem to have persisted in prosecuting their researches in a wrong direction,—misled, probably, by the term *Painting on Glass* : which has occasioned them to suppose that the splendid red of the ancient windows (the only color which they could not imitate) was produced by the old artists by methods analogous to *painting* in enamel. The fact is, however, that the old artists had nothing whatever to do with producing this color : it was provided for them, ready made, at the glass-house,—in panes, sometimes solid, but generally superficially coated, or flashed, as it is called. When, towards the end of the last century, artists began to revive the art of glass-painting, they found little difficulty, save in this one color,—the splendid red,—which gives such brilliancy to the old windows. Here lay the secret which they were unable to recover : nor were the glass makers able to assist them—the art having become extinct among them also.* Within the last thirty years, however, the glassmakers have tried the old printed receipts; and have met with such success, that I suppose nothing but a sufficient demand is wanted to ensure the production of red glass in every way equal to the ancient. It is commonly on sale now, both at home and abroad. The whole secret of the "lost art" consists in this :— that, though the *deutoxide* of copper, when melted with glass, gives a green or sky-blue color, the *protoxide* gives the red in question ; which by reflected light is dingy, but by transmitted light beautifully splendid. The difficulty is, that it requires much skill and practice on the part of the workman to prevent the copper, while the glass is in fusion, from taking up the additional dose of oxygen, and thus passing from red to green. There is another part of the secret, which is not a little curious :—that glass, though containing the proper oxide of copper when first taken out of the pot, often shows only a dirty greenish hue ; yet nothing more is needed for throwing out the fine red tint than to expose the blown glass for a few minutes to a dull red heat.

I will mention a few books where the methods may be found. There is the 'Art de la Verrerie' of Neri Merret and Kunckel, &c.—Paris, 1752. The Paris Academy, about the same time, published Leviel's ; 'Art de la Peinture sur Verre ;' but it is remarkable that, at that period, Leviel was ignorant of any transparent red whatever,—which he much laments,—and was quite mistaken as to the ancient method. Muratori gives some very ancient receipts for 'Tinctio vit-

* Modern artists, I may observe, have discovered a substitute red, which seems to have been unknown to the ancients,— viz., the red from silver ; which, though sometimes fine, can seldom bear comparison with the old red.

ri prasini,'—which I think he attributes to the age of Charlemagne. One has some difficulty in recognizing copper under the name of "*heramen.*" Baptista Porta writes as follows, about two hundred years ago,—showing that the method was then in some measure lost:—"Peritiores recentiores vitrarii in colorando smalto rosei clari coloris (vulgus rosachiero vocat), non parum insudant—videntes majores nostros—quod illud satis artificiose et pulcherrime confinxerint; nos et quæ ipsi fecimus et ab amicis habuimus recensebimus. Quod potuimus præstitimus aliis ansam præbendo meliora conficiendi. Hic erit modus rosacierum conficiendi." He then goes on to give his own method—see the edition in the British Museum, p. 257, cap. IX.

It may be worth mentioning, that French scientific men were so ignorant of the real method, that they obtained, during the Revolution, a large quantity of the red glass from the churches, for the purpose of analysis, at Paris in the expectation of finding gold. Of course, they found only copper and some iron.

"Mr. Cooper analysed some pieces of ancient red glass, and found copper, iron, and silver:—hence he concluded silver to be essential. This, however, is not the case; and the silver which he found was either accidental,—or, more probably, he had got among his pieces some of the modern, as well as the ancient, red glass."—*Annals of Philosophy*, Feb. 1824.

Athenæum.

On an Improvement in the Daguerreotype Process by the application of some new compounds of Bromine, Chlorine, and Iodine, with Lime. By R. J. Bingham, *Chemical Assistant in the Laboratory of the London Institution.*

All persons who have practiced the Daguerreotype must have remarked, that in warm weather a considerable deposition of moisture takes place upon the glass or slate cover used to confine the vapor in the bromine or accelerating pan. This moisture must also necessarily condense upon the cold metallic surface of the plate during the time it is exposed to the bromine vapor. In fact, I have been informed by a number of professional Daguerreotypists (and I have experienced the difficulty myself), that they were unable to obtain perfect pictures during the excessive heat of the late season; and a very clever and enterprising operator, who last year made a tour on the continent, and brought home some of the finest proofs I have ever seen, entirely failed this season in obtaining clear and perfect pictures, from the constant appearance of a mist or cloud over the prepared surface. This appears to be caused by the deposition of moisture upon the plate, arising from the water in which the bromine is dissolved. To obviate this some have recommended the pan to be kept at a low temperature in a freezing mixture; and M. Daguerre, in a communication to the French Academy of Sciences, recommends the plate to be heated; but in practice both these plans are found to be unsuccessful. (See Lerebour's *Traité de Photographie.)*

It appeared to me, that if we could avoid the use of water altogether in the accelerating mixture, not only would the difficulty I have mentioned be avoided, but a much more sensitive surface would be obtained on the plate. With this view I endeavored to combine bromine with lime, so as to form a compound analogous to bleaching powder. In this I was successful, and find that bromine, chloride of iodine, and iodine, may be united with lime, forming compounds having properties similar to the *so-called* chloride of lime.

The bromide of lime* may be produced by allowing bromine vapor to act upon hydrate of lime for some hours: the most convenient method of doing this is to place some of the hydrate at the bottom of a flask, and then put some bromine into a glass capsule supported a little above the lime. As heat is developed during the combination, it is better to place the lower part of the flask in water at the temperature of about 50° F.: the lime gradually assumes a beautiful scarlet color, and acquires an appearance very similar to that of the red iodide of mercury. The chloro-iodide of lime may be formed in the same manner: it has a deep brown color. Both these compounds, when the vapor arising from them is not too intense, have an odor analogous to that of bleaching powder, and quite distinguishable from chlorine, bromine, or iodine alone.

Those Daguerreotypists who use chlorine in combination with bromine, as in Wolcott's American mixture, or M. Guérin's Hungarian solution, which is a compound of bromine, chlorine, and iodine, may obtain similar substances in the solid state, which may be used with great advantage. By passing chlorine over bromine, and condensing the vapors into a liquid, and then allowing the vapor of this to act upon lime, a solid may be obtained having all the properties of the American accelerator; or by combining the chloro-iodide of lime with a little of the bromine, a mixture similar to that of M. Guérin's may be produced: but I greatly prefer, and would recommend the pure bromide of lime, it being, as I believe, the quickest accelerating substance at present known. By slightly coloring the plate with the chloro-iodide, and then exposing it for a proper time over the bromide, proofs may be obtained in a fraction of a second, even late in the afternoon. A yellow color should be given by the use of the first substance; and the proper time over the bromide is readily obtained by one or two trials. With about a drachm of the substance in a shallow pan, I give the plate ten seconds the whole of the first day of using the preparation, and add about three seconds for every succeeding one. The compound should be evenly strewed over the bottom of the pan, and will last with care for about a fortnight.

The great advantage of this compound is, that it may be used continuously for a fortnight without renewal; and, unlike bromine water, its action is unaffected by the ordinary changes of temperature.

* I call this substance bromide of lime, although there is a difficulty as to the composition of bleaching powder, and which would also apply to the compounds I describe. Some chemists regard the *chloride of lime* to be a compound of lime, water, and chlorine. Balard thinks it is a mixture of hypochlorite of lime and chloride of calcium; and the view of Millon and Prof. Graham is, that it is a protoxide of lime, in which 1 equivalent of oxygen is replaced by 1 of chlorine.

I have hastened to communicate this during the present fine weather, believing that it will be acceptable to all interested in this beautiful application of science.

September 14, 1846. Lon. Ed. & Dub. Phil. Mag.

Iron Furnaces.

The best constructed furnaces in South Wales, are those at the Abersychan Iron Works; in Staffordshire, those built by Mr. Gibbon, at Corbyn's Hall, claims pre-eminence; and in Scotland, the furnaces at Dundyvan may be considered the most complete. Mr. Gibbon's furnaces are of the best construction at present adopted; but even these are far from having attained the limit to which an improvement in construction might be carried. By a different mode of construction, the furnaces at present in blast in the United Kingdom would readily afford an increased yield and superior quality of iron, amounting to 50 per cent. upon the quantity at present manufactured. The greatest yield of pig-iron, when the size of the furnace is taken into consideration, has been obtained at the Parkend furnace, where 140 tons of forge pigs have, I believe, been produced from a furnace containing 3400 cubic feet of materials in a single week. This great result is, however, solely to be attributed to the surpassing richness and fusibility of the iron ore, peculiar to the Forest of Dean, in which this furnace is situated. The best constructed forge and mill is the new one at Cyfarthfa, belonging to Mesrss. Crawshay. The best form of constructing hot blast pipes is, I believe, my own—viz.: a spiral tube of cast-iron; each thread of revolution of which is composed of two very flat elliptical segments of piping, 15 to 20 inches inside measure in width, by 3 to 4 inches in depth. The spiral tube thus formed, by jointing together these segments, to consist of as many revolutions as may be deemed sufficient; the more in number, of course, the greater will be the heating surface, and the less will be the amount of fuel required to heat the air. The complete tube to be enclosed by a cylinder of brick-work, heated like a common flue; the cold air to enter at the upper and cooler extremity of the tube, and, after descending along the heated spiral, to make its exit at the lower extremity, where the heat will be at a maximum. Hot-blast pipes thus constructed, and protected by brick-work, will last for an indefinite length of time; they will, likewise, admit of a maximum amount of heating surface, and facility of heating the air—whilst a minimum amount of fuel will be required to heat that air. Less friction will, likewise, be found to take place with such pipes than occurs in pipes constructed by the ordinary methods; whilst a temperature of a 1000° may be given to the air, with less danger to the safety and endurance of the pipes, than is at present incurred by them in obtaining a temperature of 500° to 600°. There is, however, no necessity for employing so expensive a material as cast-iron in the construction of hot-blast stoves: and I have long contemplated the adoption of a species of cement, which I have tested, to form an imperishable tub-

ing, capable of withstanding a heat which would speedily melt cast-iron pipes.—Mr. R. Mushet. Min. Jour.

Report made by M. Dumas, of the Committee of Chemical Arts at Paris, on a work of M. J. Persoz, entitled, "A Theoretical and Practical Treatise on the Printing of Tissues."

The Society of Encouragement had offered a prize for the best treatise on the bleaching of tissues, and the manufacture of printed stuffs. Several years ago the sittings of the Society were discontinued, and the papers which had been received were deliberated upon, but none of these papers having been deemed worthy of the prize, the Society struck off this subject from their list.

However, one of our most skilful chemists, who was fortunately enabled to undertake and accomplish this difficult task, had devoted himself to it from the time that the Society's proposal was first made known; and although he was far from being satisfied with his work, when it was determined to withdraw the prize for this subject from the Society's programme, he thought it a duty he owed to the Society to persevere in the task which it had opened for him.

M. Persoz, Professor of Sciences, of Strasbourg, has now laid before you the result of his long and arduous researches, which he has combined in four beautiful volumes, accompanied by a specimen book of the most elaborate execution.

M. Persoz was born amongst the manufactures of printed calicoes; he passed the whole of his life in this occupation, and being fortunately situated in Alsace, in the very centre of our manufactories of printed calicoes, for the purpose of giving instruction in chemistry, every assistance was thus afforded him.

His work embraces every detail of this branch of industry; and his personal opinion is given, even in the midst of the most accurately collected information, and wisely discussed opinions; for such is the right of every author who has practised everything by himself, and who relies upon his own experience in all things.

Two volumes are devoted to the subject of coloring matter, the theory of dyeing, and the various processes of printing in colors, and also the nature and effect of the various machines used in this branch of industry.

Two other volumes contain an accurate description of all the processes of printing which are practised upon cotton and other stuffs of a similar description.

To each receipt is added a sample of the stuff, which gives the reader a faithful representation of the effect produced by the ingredients.

These samples, several hundred in number, exhibit the state of the art in all countries; for Alsace, Switzerland, Normandy, the environs of Paris, and England, and Scotland, have vied in liberality towards the author. He has received from the principal manufactures pieces of the stuffs, which, being cut into samples, are invaluable models to the reader.

By simple, new, and rapid processes, the author enables each manufacturer to define, himself, with great accuracy, the exact nature of the processes used for producing any color on a given fabric. This system of assay, from its precision and importance, does honor to the intelligence of M. Persoz, and will render the greatest services to the trade.

The Society has deemed it right to award to the author of this remarkable work a recompense in accordance with the services which it is calculated to render, and has therefore voted him a medal of the value of 3000 francs.

Desirous, however, of giving to the author and editor, whose zeal for the publication of this elaborate work is worthy of all praise, a further testimony of its great satisfaction, the Society has decided in adopting this treatise as the head of the collection of which they propose to favor the publication. In consequence of which the editor is authorized to place at the head of his work, a general title, bearing the following words:—"Library of the Manufacturing Arts, published under the auspices of the Society of Encouragement of National Industry and Chemical Arts."

Lastly.—The Society has decided on awarding this work as a prize to the various foremen in the manufactories of printed calicoes or other fabrics, who shall have merited this distinction.

Lond. Journ. of Arts and Sci.

Opening of the Enlarged Schuylkill Navigation.

This great work, which was begun last year, is now open for use. The first of the large coal barges, "the General Taylor," reached Philadelphia from the coal region on Saturday, November 21st. The improvement consists in increasing the capacity of the navigation to three fold what it was before, and in diminishing the number of locks more than one third. The new locks are 110 feet long and 18 feet wide in the chamber, being the size of those of the enlarged Erie canal of New York. When the deepening of some of the channels is completed, barges, carrying two hundred tons of anthracite coal, will be able to pass from Pottsville, via Philadelphia, to New York, without transhipment; which will be of vast advantage to the coal trade of Pennsylvania. R.

Deepest Artesian Well in Europe.

In the Duchy of Luxembourg, a well is being sunk, the depth of which surpasses all others of the kind. Its present depth is 2336 feet, nearly 984 feet more than that of la Grenelle, near Paris. It is said, that this immense work has been undertaken for working a large stratum of rock salt.

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LIST OF AMERICAN PATENTS, WITH REMARKS, &c.